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February 20, 1997

VIA FEDERAL EXPRESS

Mr. James E. Kennedy, Sr.
 Low-Level Waste & Decommissioning Projects Branch
 Nuclear Regulatory Commission
 11545 Rockville Pike
 Mail Stop T7F27
 Rockville, MD 20852

Re: Requested Documents

Dear Jim:

Enclosed, as you requested, are six copies of the Memorandum of Understanding of Settlement ("MOU") and supporting materials setting forth the court-approved settlement in the Cambridge, Ohio "toxic tort" case, *Allen Strawsburg v. Metallurg, Inc. et al. (consolidated with Sue Ann Malernee v. Cabot Corp.)*. The enclosures are as follows:

1. The Court Order, dated December 30, 1996, in which the Court approved the MOU;
2. The Magistrate Judge's Report and Recommendation to the Court (dated December 5, 1996) recommending that the Court approve the MOU;
3. The Court Order, dated December 6, 1996, adding Sue Ann and Edward Malernee as additional class representatives; and
4. A bound set of documents including the MOU (the second document in the set) and the memorandum in support of approval of the MOU.

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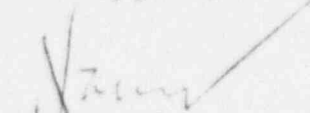
Mr. James E. Kennedy, Sr.

February 20, 1997

Page 2

I hope you will find these materials helpful. Please give me a call if I can be of further assistance.

Sincerely yours,

A handwritten signature in dark ink, appearing to read 'Nancy N. Young', with a long, sweeping horizontal stroke extending to the right.

Nancy N. Young

Enclosures

OACLD15203792LTR3792NNY.02

FILED
KENNETH J. MURPHY
CLERK

96 DEC -6 AM 10:06

U.S. DISTRICT COURT
SOUTHERN DIST. OHIO
EAST. DIV. COLUMBUS

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLEN STRAWSBURG, et al.,
Plaintiffs,

vs.

Civil Action 2:94-CV-1069
Judge Smith
Magistrate Judge King

METALLURGIC, INC., et al.,
Defendants,

and

SUE ANN MALERNEE, et al.,
Plaintiffs,

vs.

Civil Action 2:95-CV-248
Judge Smith
Magistrate Judge King

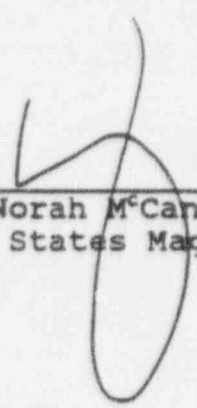
CABOT CORPORATION, et al.,
Defendants.

ORDER

This matter is before the Court on the December 4, 1996 motion of Sue Ann and Edward Malernee to appoint them as additional representatives of the class of plaintiffs certified in this matter and to determine that they may participate in the distribution of funds provided for class representatives in the Memorandum of Understanding, Exhibit 1, attached to Motion for Preliminary Approval of Class Action Settlement and for Class Certification for Settlement Purposes (June 14, 1996) ["MOU"]. At the fairness hearing held on December 4, 1996, it was apparent that there is no

objection to the motion. Moreover, counsel for defendant Cyprus Foote indicated that it would increase the funds provided for class representatives to reflect the addition of the Malernees so as not to dilute the amount to which the remaining class representatives are entitled.

The December 4, 1996 motion is GRANTED. Sue Ann and Edward Malernee are added as class representatives of the class of plaintiffs in this matter and may participate in the distribution of the fund provided for class representatives in the MOU, as increased by defendant upon the grant of this motion.



Norah McCann King
United States Magistrate Judge

FILED

12/6/96

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

FILED
KENNETH J. MURPHY
CLERK

96 DEC -5 PM 4:52

U.S. DISTRICT COURT
SOUTHERN DIST. OHIO
EAST. DIV. COLUMBUS

ALLAN STRAWSBURG, et al.,
Plaintiffs,

vs.

Civil Action 2:94-CV-1069
Judge Smith
Magistrate Judge King

METALLURG, INC., et al.,
Defendants.

and

SUE ANN MALERNZEE, et al.,
Plaintiffs,

vs.

Civil Action 2:95-CV-248
Judge Smith
Magistrate Judge King

CABOT CORPORATION, et al.,
Defendants.

REPORT AND RECOMMENDATION

These consolidated actions seek relief arising from the presence of allegedly radioactive slag material on residential properties located in Guernsey County, Ohio. Plaintiffs allege that Cyprus Foote Minerals Company, the only remaining defendant in this case, is responsible for the alleged radioactive contamination. On September 24, 1996, this Court granted

provisional certification of a class of plaintiffs for settlement purposes, pursuant to Fed. R. Civ. P. 23(b)(1) and 23(b)(2), and granted preliminary approval of the proposed settlement. This Court also approved the proposed notice of settlement to the class. This matter is now before the Court for final approval of this class action settlement. The matter was referred to the undersigned, 28 U.S.C. §636(b)(1)(B), Order (December 3, 1996), and a formal fairness hearing was held, pursuant to Fed. R. Civ. P. 23(e), on December 4, 1996.

I

The proposed settlement is contained in the Memorandum of Understanding ("MOU") filed by the parties on June 14, 1996. Exhibit 1, attached to Motion for Preliminary Approval of Class Action Settlement and for Class Certification for Settlement Purposes.

A

The mandatory non-opt out class defined in the proposed settlement relates to more than one hundred (100) residential properties and is composed of four mutually exclusive subclasses of persons who own or reside in residential property containing the slag, whether or not subsequently removed, generated from production operations of Foote Mineral Company and its predecessors prior to May 13, 1987 at the Byesville, Ohio plant. The presence at some point of the slag on the class properties presents issues of both fact and law common to the class. Moreover, it is

undisputed that each of the representative plaintiffs is a member of one of the subclasses described in the MOU. Finally, the record in this action bears witness to the fact that both the representative plaintiffs and their counsel have vigorously represented the interests of the class. The prerequisites to class certification, F.R.Civ.P. 23(a)(1) - (4), have therefore been satisfied. See Senter v. General Motors Corp., 532 F.2d 511, 523 (6th Cir. 1977), cert. denied 429 U.S. 870 (1978).

The proposed settlement also contemplates certification of the class of plaintiffs under the provisions of F.R.Civ.P. 23(b)(1)(A) and 23(b)(2). As will be more thoroughly addressed infra, the primary feature of the proposed settlement agreement is injunctive relief in the form of evaluation and remediation or purchase of the affected properties. Although the proposed settlement agreement also contemplates monetary relief to the members of the plaintiff class, that relief may properly be characterized as incidental to the primary injunctive relief. Because the common claim of the plaintiff class is subject to a single injunctive remedy, then, certification of the plaintiff class under F.R.Civ.P. 23(b)(2) is appropriate. See Senter v. General Motors Corp., supra, 532 F.2d at 525. Moreover, because the prosecution of separate actions would impose on defendant an unreasonable risk of inconsistent results and conflicting standards of conduct, certification of the plaintiff class under F.R.Civ.P. 23 (b)(1)(A) is likewise appropriate. See Bendectin Prods. Liab. Litig., 749 F.2d 300, 305 (6th Cir. 1984).

B

A total of \$850,000.00 has been set aside by defendant to fund the settlement. The settlement agreement sets forth the injunctive relief to which the members of the subclasses are entitled and to which the defendant has agreed to be bound. Subclass 1 is entitled to receive one lump sum payment of \$40,000 from the fund, and the defendant "shall purchase and/or remediate the identified properties in Subclass 1." (MOU at ¶12). Similar terms apply to Subclass 2, except that the members of this subclass are to receive a lump sum payment of \$20,000. The agreement provides that the purchase option shall be at the defendant's sole discretion, after consultation with the individual property owner. Remediation is to consist of the excavation and removal of slag. There are explicit provisions regarding the time period for purchase or remediation of the property, as well as appeal, in the event of disagreement, to an implementation master or trustee appointed by the Court consistent with Paragraph 9 of the MOU. (*Id.* at ¶12-13).

The properties of members of Subclass 3 are to undergo radon testing. If the results of a radon test exceeds 4 pCi/l, the property owner will be entitled to radon mitigation at the defendant's expense. (*Id.* at ¶14). Owners of properties in Subclass 3 are to receive a payment of \$15,000 from the fund or 10% of the appraised value of the property. (*Id.*).

Members of Subclass 4 are to have their properties evaluated pursuant to explicit terms contained in ¶17, and are entitled to a

payment of \$5,000 from the fund. (Id. at ¶13). Defendant also agrees to pay a lump sum amount to the Court-appointed class representatives from the established fund (Id. at ¶20).¹

The MOU contemplates the release of all claims of members of the plaintiff class against the defendant, except unknown future individual claims for latent physical injuries "that have not manifested themselves up to the effective date of the Settlement." (Id. at ¶6).

Finally, the defendant has agreed to pay the reasonable attorney and expert fees and expenses of lead class counsel that have been approved as fair and reasonable by the Court. (Id. at ¶21).² In this regard, lead class counsel and defense counsel stipulated, at the fairness hearing, that lead class counsel's request for attorney and expert fees and expenses in the amount of \$750,000.00 is fair and reasonable, subject only to further itemization by lead class counsel, and subject further to the \$200,000.00 limitation on expert fees contained in Paragraph 21 of the MOU.

On December 4, 1996, associate class counsel filed a motion to approve payment of attorney fees and litigation costs in the amount of \$485,990.25. While defense counsel conceded at the fairness

¹By separate order and without objection, the Court has granted the motion of Sue Ann and Edward Malernee to be designated as additional class representatives. Defendant Cypress Foote has agreed to increase this portion of the fund to reflect the addition of two class representatives and so as not to dilute the portion of the fund to which the other class representatives are entitled.

²It is agreed that no portion of the \$850,000.00 settlement fund will be used for payment of these expenses.

hearing that associate class counsel is entitled to some payment, no agreement has been reached regarding the reasonableness of the amounts sought by associate class counsel. IT IS HEREBY ORDERED that defendant may have until December 13, 1996 to file a memorandum contra the motion to approve payment of attorney fees and litigation costs filed by associate class counsel, and IT IS FURTHER ORDERED that associate class counsel may have until December 17, 1996 to reply in support of the motion.

II

Notice of this proposed class action settlement was properly made. That notice explicitly required that objections were to be filed with the Court no later than November 24, 1996. No objection was filed by that date and, indeed, no member of the class has raised any objection whatsoever to the proposed settlement.³

On November 25, 1996, a document captioned Notice of Intent to Appear at Fairness Hearing on December 2, 1996 [sic] was filed by one Michael Bruce Gardner "on behalf of the public, in the public interest and in the interest of promoting public confidence in the integrity of the legal system" Mr. Gardner, who is an attorney and who was present at the fairness hearing on December 4, 1996, acknowledged that he does not represent any named plaintiff

³On October 9, 1996, a number of persons, including Sue Ann and Edward Malernee, filed Objections to Class Notice and Class Notice Procedure. At the fairness hearing held on December 4, 1996, their counsel, Steven D. Bell, expressly withdrew any objection previously raised by him on behalf of these persons and indicated that he was aware of no objection to the terms of the proposed settlement by any member of the plaintiff class.

or member of the plaintiff class; ⁶ he nevertheless expressed his intention to object to certain portions of the proposed settlement. Because Mr. Gardner is not a member of the class of plaintiffs and does not represent any named party or class member, Mr. Gardner cannot be heard in this matter. Moreover, Mr. Gardner has never actually filed an objection to any portion of the proposed settlement. In any event, his notice of intent to appear at the fairness hearing -- even if construed as an objection -- was untimely.

III

This Court must now determine whether the agreement is fair, adequate and reasonable. See Baily v. Great Lakes Canning, Inc., 908 F.2d 38, 42 (6th Cir. 1990); United States v. Jones & Laughlin Steel Corp., 804 F.2d 348, 351 (6th Cir. 1986). The agreement may not be the result of fraud or collusion between the parties. See Ohio Public Interest Campaign v. Fisher Foods, 546 F.Supp. 1 (N.D. Ohio 1982). Approval of a proposed class action settlement falls within the discretion of the Court. Id.

Various factors should be considered by the Court in evaluating a proposed class action settlement, including balancing the likelihood of plaintiffs' ultimate success against the amount and form of relief offered in the settlement; the expense, complexity and duration of the litigation; the judgment of

⁶Apparently, Mr. Gardner was formerly associated with Steven D. Bell, who continues to represent certain members of the plaintiff class, including Sue Ann and Edward Malernee.

experienced trial counsel; any objections by class members; and the public interest in the settlement. Bronson v. Bd. of Educ. of City School Dist. of City of Cincinnati, 604 F.Supp. 68, 73 (S.D. Ohio 1984); Williams v. Vukovich, 720 F.2d 909, 922 (6th Cir. 1985).

Applying these factors to the proposed settlement presently before it, this Court concludes that the proposed settlement is reasonable, fair and adequate. The terms of the proposed settlement results from extensive community and scientific investigation into the alleged radioactive contamination, and reflects careful consideration by all sides. The comprehensive nature of the relief offered is extremely favorable to plaintiffs and the members of the plaintiff class. Moreover, the relief available under the proposed settlement in relation to radon remediation in all likelihood would not have been a remedy to which plaintiffs would have been entitled had this action proceeded to trial.⁵ Finally, although the proposed settlement contemplates a release of most claims by the members of the plaintiff class against defendant, the proposed settlement does not contemplate the release of "any currently unknown future individual claims for compensatory damages for latent physical injuries proximately caused by the slag . . . that have not manifested themselves up to the effective date of the Settlement." (MOU, at ¶6).

Consideration of the possible expense, duration, and

⁵Lead class counsel conceded at the fairness hearing that establishing at trial a legally significant correlation between the radioactive slag and the presence of radon in certain properties would have been difficult if not impossible.

complexity of this litigation also weighs in favor of the proposed settlement. Defendant remains firm in its position that the slag presents no unreasonable risk of immediate medical damage or other harm; the proposed settlement relieves that plaintiff class of the not insubstantial burden of proving otherwise. The judgment in favor of the proposed settlement on the part of the experienced trial counsel on both sides of this action also leads this Court to conclude that settlement is appropriate. Likewise important is the fact that no objections to the proposed settlement have been filed by any named plaintiff or class member. Finally, the proposed settlement, which will avoid protracted litigation while at the same time provide a comprehensive remedy to the plaintiff class, serves well the interests of the citizens of Guernsey County and the residents of eastern Ohio.

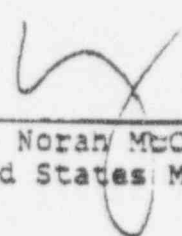
This Court therefore concludes that the proposed settlement agreement is reasonable, fair and adequate and that this action should be compromised pursuant to the terms of said agreement.

It is therefore RECOMMENDED that final approval of the class action settlement, as reflected in the parties' Memorandum of Understanding of Settlement, be GRANTED. It is SPECIFICALLY RECOMMENDED that a mandatory, non-opt out class of plaintiffs consisting of all persons who own or reside in residential property containing slag (whether or not subsequently removed) generated from production operations of Foote Mineral Company and its predecessors prior to May 13, 1987, at the plant currently owned by

ShieldAlloy Metallurgical Corporation located in Byesville, Ohio, be certified under F.R.Civ.P. 23(b)(1)(A) and 23(b)(2). It is also SPECIFICALLY RECOMMENDED that, in the event that the Court adopts this Report and Recommendation, the Court appoint in the order approving the proposed settlement an implementation master as contemplated by Paragraph 9 of the parties' Memorandum of Understanding.

If any party seeks review by the District Judge of this Report and Recommendation, that party may, within ten (10) days, file and serve on all parties objections to the Report and Recommendation, specifically designating this Report and Recommendation, and the part thereof in question, as well as the basis for objection thereto. 28 U.S.C. §636(b)(1).

The parties are specifically advised that failure to object to the Report and Recommendation will result in a waiver of the right to de novo review by the District Judge and of the right to appeal the decision of the District Court adopting the Report and Recommendation. See Thomas v. Arn, 474 U.S. 140 (1985); Smith v. Detroit Federation of Teachers, Local 231, etc., 829 F.2d 1370 (6th Cir. 1987); Harris v. City of Akron, 20 F.3d 1396 (6th Cir. 1994).



Norah McCann King
United States Magistrate Judge

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

FILED
CLERK
NOV 23 1996
U.S. DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLEN STRAWSBURG, et al.,
Plaintiffs,

vs.

Civil Action 2:94-CV-1069
Judge Smith
Magistrate Judge King

METALLURGIC, INC., et al.,
Defendants,

and

SUE ANN MALERNEE, et al.,
Plaintiffs,

vs.

Civil Action 2:95-CV-246
Judge Smith
Magistrate Judge King

CABOT CORPORATION, et al.,
Defendants.

ORDER

On December 5, 1996, the United States Magistrate Judge issued a Report and Recommendation recommending that the Court grant final approval of the proposed class action settlement as reflected in the parties' Memorandum of Understanding of Settlement (Exhibit 1, attached to Motion for Preliminary Approval of Class Action Settlement and for Class Certification for Settlement Purposes) (hereinafter "MOU"). It was specifically recommended that the Court certify under F.R. Civ. P. 23(b)(1)(A) and 23(b)(2) a mandatory, non-opt out class of plaintiffs consisting of all

persons who own or reside in residential property containing slag (whether or not subsequently removed) generated from production operations of Foote Mineral Company and its predecessors prior to May 13, 1987, at the plant currently owned by ShieldAlloy Metallurgical Corporation located in Byesville, Ohio. Finally, it was specifically recommended that the Court appoint an implementation master as contemplated by Paragraph 9 of the parties' MOU.

I

On November 25, 1996, one Michael Bruce Gardner filed a document captioned Notice of Intent to Appear at Fairness Hearing on December 2, 1996 [sic]. Although Mr. Gardner was apparently present at the fairness hearing and expressed an intention to address the terms of the proposed settlement, he was not permitted to do so:

Because Mr. Gardner is not a member of the class of plaintiffs and does not represent any named party or class member, Mr. Gardner cannot be heard in this matter. Moreover, Mr. Gardner has never actually filed an objection to any portion of the proposed settlement. In any event, his notice of intent to appear at the fairness hearing -- even if construed as an objection -- was untimely.

Report and Recommendation, at 7. However, although he made no mention of it at the fairness hearing, Mr. Gardner had also filed with the Office of the Clerk immediately prior to the fairness hearing a written argument "on behalf of absent and unidentified members of the provisionally-certified settlement class, tendered

at the fairness hearing on December 4, 1996." In that document, Mr. Gardner acknowledges that he represents no named plaintiff or "any specific class member." Argument, on Behalf of Absent and Unidentified Members of the Provisionally-Certified Settlement Class ..., at 1 (December 4, 1996). Instead, Mr. Gardner contends that he represents "those who, ... will be bound by the Court's judgment in this matter but, who will not have received any consideration." Id. at 2.

Finally, Mr. Gardener filed objections to the Report and Recommendation. Objection to Report and Recommendation filed December 5, 1996 (December 16, 1996). Although he acknowledges that he does not represent any named plaintiff or member of plaintiff class, Mr. Gardner argues that, because of his former association with Ulmer & Berne, counsel for the named plaintiffs in Sue Ann Malernee v. Cabot Corp., C-2-95-248, he continues to have professional obligations to those named clients and to a class of persons represented by those clients.¹ Mr. Gardner appears to take the position that, despite the fact that he is no longer associated with Ulmer & Berne, he may continue to represent the named plaintiffs in Malernee v. Cabot Corp. and certain absent class members:

Those clients did not terminate the attorney-client relationship with the undersigned -- the undersigned's former employer terminated its relationship with the undersigned No one has been finally adjudicated to represent the absent class members. No one

¹No class has ever been certified in Malernee v. Cabot Corp.

has been finally adjudicated not to represent the absent class members. This is not a well-settled area of the law. Moreover, whether the undersigned actually represents anyone, is largely academic and irrelevant to the fairness of the proposed class action settlement.

Objection to Report and Recommendation filed December 5, 1996, at 13-14. Although the Court concludes that Mr. Gardner has no standing to register objections to either the proposed settlement or the Report and Recommendation, the Court will nevertheless consider his arguments.

Mr. Gardner contends, first, that the injunctive relief contemplated by the proposed settlement fails for lack of adequate consideration because it contemplates only such identification, evaluation and remediation of properties that Cypress Foote would in any event be required to perform under its existing legal obligations. Even if Mr. Gardner's objection in this regard is credited, the argument wholly fails to consider the MOU as it relates to the presence of radon in certain class properties. As the Report and Recommendation states,

The relief available under the proposed settlement in relation to radon remediation in all likelihood would not have been a remedy to which plaintiffs would have been entitled had this action proceeded to trial.

Report and Recommendation at 8. The Report and Recommendation also reflected lead class counsel's concession at the fairness hearing that "establishing at trial a legally significant correlation between the radioactive slag and the presence of radon in certain properties would have been difficult if not impossible." Id. at

8n5. The injunctive relief contemplated by the MOU is, in the Court's estimation, both substantial and supported by legal consideration.

Mr. Gardner also objects to that portion of the MOU that provides that, if the number of class properties increases by 10 percent or more above the number of properties identified in the MOU, then the defendant, in its sole discretion, may terminate the settlement. See MOU, ¶3A. Because there is no indication that this provision of the MOU has been invoked, the Court will not decline to grant final approval of the settlement on this basis.

Mr. Gardner also argues that persons who either own or reside on contaminated property, but who have not been identified prior to final approval of the settlement agreement, will be prejudiced by the proposed settlement because the MOU contemplates a release of claims by all members of the class, even those not presently identified. Significantly, Mr. Gardener has presented nothing more than a theoretical possibility that any such person exists. The parties and counsel in this litigation have persuaded the Court that actual notice has been given directly to all members of the class actually identified, and that publicity to the general populace in and around Guernsey County, Ohio, regarding the litigation and the proposed settlement has been intense. Rather than present to the Court any reason to conclude that any such person or persons exist, Mr. Gardener merely asks:

What would be so onerous to the subsidiary of a billion-dollar company to provide for the same amount, degree and type of compensation, to the unidentified class members, whose

claims surface over the next thirty years or whatever period determined by the court. The funds used for those potential claimants, could be controlled by the same trustee as now provided for, and would revert to Cypress Foote to the extent they are not used to pay claims of the now unidentified class members.

Argument, on Behalf of Absent and Unidentified Members of the Provisionally-Certified Settlement Class, at 5. To require Cypress Foote to subject itself to indeterminate liability over the course of "the next 30 years or whatever period determined by the court" is unreasonable, particularly in light of the fact that it does not appear, either from the information provided by counsel in these cases or by Mr. Gardner himself, that there exists any such person who could actually benefit from such a provision.

Mr. Gardner also refers to the fact that not all sites that may fall within the class definition have yet been surveyed or evaluated. Argument, on Behalf of Absent and Unidentified Members of the Provisionally-Certified Settlement Class, at 3. The fact that certain sites identified as being potentially contaminated had not, as of March 1996, been evaluated is irrelevant to whether or not vigorous attempts to identify all members of the class have been made and actual notice given to all such persons. Indeed ¶17 of the MOU anticipates further evaluation. In short, the Court concludes that Mr. Gardner's actual objections to the proposed settlement and to the Report and Recommendation are without merit.

The Court has carefully considered Mr. Gardner's remaining objections to the Report and Recommendation and find them

to be without merit.²

II

The Court has also received a letter dated December 9, 1996, from Joseph R. and Martha A. Seresun. Apparently, Mr. Seresun was a contractor in past years who hauled the radioactive slag. The Seresun letter expresses some concern because the proposed settlement does not relieve Mr. Seresun of all potential liability. The fact that the proposed settlement does not resolve every potential claim against every potential defendant in connection with radioactive slag does not militate against final approval of the proposed settlement. The Seresuns also appear to claim membership in the plaintiff class. Although the record is not clear in this regard, all counsel agree that, if the Seresuns can establish either ownership of or residency in qualifying property, they will be afforded the remedies contemplated by the MOU.

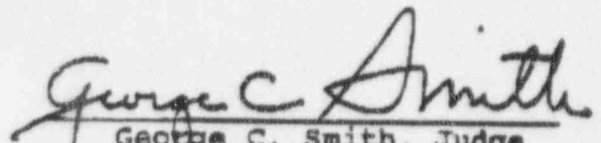
The other objections made by Mr. Gardner merit little discussion. The Report and Recommendation did consider the numerosity requirement for class action certification under F.R. Civ. P. 23(a)(1). The Report and Recommendation noted, on pages 2 and 3, that the proposed class consists of owners or residents of more than 100 residential properties. Certainly, as the Report and Recommendation noted, this satisfies the numerosity requirement of F.R. Civ. P. 23(b)(1). Mr. Gardner also appears to argue that there should be certified a separate subclass of plaintiffs consisting of unidentified persons; because there is no representative plaintiff for this subclass, Mr. Gardner contends, the Court should reject the Report and Recommendation. This argument is specious.

III

Finally, the Court has carefully considered the Report and Recommendation, but notes one error. The Report and Recommendation erred in referring to the request for attorney's fees and expenses submitted by lead class counsel. The parties actually stipulated at the fairness hearing that lead counsel's request for attorney's fees in the amount of \$750,000.00 is fair and reasonable and that defendant has agreed to pay an additional \$200,000.00 in expert fees and costs, with the latter figure subject to defendant's review to ensure that such fees and costs are reasonable.

With that modification, the Court ADOPTS and AFFIRMS the Report and Recommendation. The parties' Memorandum of Understanding of Settlement is approved. Moreover, the Court hereby CERTIFIES under F.R. Civ. P. 23(b)(1)(A), 23(b)(2) a class of plaintiffs consisting of all persons who own or reside in residential property containing slag (whether or not subsequently removed) generated from production operations of Foote Mineral Company and its predecessors prior to May 13, 1987, at the plant currently owned by ShieldAlloy Metallurgical Corporation located in Byesville, Ohio. Moreover, the Court hereby APPOINTS Keith W. Schneider, Esq., of Maguire & Schneider, 580 South High Street, Suite 330, Columbus, Ohio 43215, as the implementation master contemplated by Paragraph 9 of the parties' Memorandum of Understanding of Settlement.

The Clerk shall enter FINAL JUDGMENT in these actions.


George C. Smith, Judge
United States District Court

IN THE UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLAN STRAWSBURG, <u>et al.</u>,	)	CASE NO. C2-94-1069
	)	CONSOLIDATED WITH
Plaintiffs,	)	CASE NO. C2-95-248
)	
v.	)	JUDGE SMITH
)	
	)	MAGISTRATE JUDGE KING
)	
METALLURG, INC., <u>et al.</u>,	)	MOTION FOR PRELIMINARY
	)	APPROVAL OF CLASS ACTION
Defendants.	)	SETTLEMENT AND FOR CLASS
	)	CERTIFICATION FOR
	)	<u>SETTLEMENT PURPOSES</u>

Cyprus Foote and Legal Class Counsel, by and through their respective attorneys, respectfully move this Honorable Court to preliminarily approve the settlement reached between them and to provisionally certify a class for settlement purposes only pursuant to Fed. R. Civ. Pro. 23(b)(1)(A) and 23(b)(2) for the reasons set forth in the Memorandum of Points and Authorities in Support of Preliminary Approval of Class Action Settlement and Certification

of a Class for Settlement Purposes filed herewith and incorporated as if fully rewritten herein.

Respectfully submitted,

ALEXANDER, RAPAZZINI & GRAHAM

Mark P. Rapazzini *for Paul D. Jesse*
Richard Alexander, Esq.

Mark P. Rapazzini, Esq.

M. Elizabeth Graham, Esq.

55 Market Street, Suite 1080

San Jose, California 95128

(408) 289-1776

PER TELEPHONE AUTHORIZATION

Lead Class Counsel

CLIMACO, CLIMACO, SEMINATORE,
LEFKOWITZ & GAROFOLI CO., L.P.A.

Robert B. Casarona *for Paul D. Jesse*
John R. Climaco (0011456)

Robert B. Casarona (0036715)

Paul D. Jesse (0058664)

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(216) 621-8484 (Telephone)

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Trial Attorney for Defendant
Cyprus Foote Minerals Company

IN THE UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLAN STRAWSBURG, et al.,
Plaintiffs,

v.

METALLURG, INC., et al.,
Defendants.

) CASE NO. C2-94-1069
) CONSOLIDATED WITH
) CASE NO. C2-95-248
)

) JUDGE SMITH
)

) MAGISTRATE JUDGE KING
)

) MEMORANDUM OF POINTS AND
) AUTHORITIES IN SUPPORT OF
) PRELIMINARY APPROVAL OF
) CLASS ACTION SETTLEMENT AND
) FOR CERTIFICATION OF A
) SETTLEMENT CLASS PURSUANT
) TO FED. R. CIV. PRO. 23(b)(1)(A)
) AND 23(b)(2)

TABLE OF AUTHORITIES

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IN THE UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLAN STRAWSBURG, <u>et al.</u>,	)	CASE NO. C2-94-1069
	)	CONSOLIDATED WITH
Plaintiffs,	)	CASE NO. C2-95-248
)	
v.	)	JUDGE SMITH
)	
	)	MAGISTRATE JUDGE KING
)	
METALLURG, INC., <u>et al.</u>,	)	MEMORANDUM OF POINTS AND
	)	AUTHORITIES IN SUPPORT OF
Defendants.	)	PRELIMINARY APPROVAL OF
)	<u>CLASS ACTION SETTLEMENT</u>

I. INTRODUCTION: NATURE AND SCOPE OF THE PROPOSED SETTLEMENT

Defendant Cyprus Foote Mineral Company ("Cyprus Foote") and the Class Plaintiffs have reached a Settlement. The Memorandum of Understanding ("MOU"), attached as Exhibit 1, sets forth the proposed final settlement between Cyprus Foote and Class Plaintiffs of all claims asserted in the above-captioned consolidated cases (hereinafter referred to as the "Settlement") once approved by the Court as a fair and reasonable Settlement.

The facts underlying this case arose when the United States Nuclear Regulatory Commission ("NRC") began an investigation into slag that had been produced at the Shieldalloy plant in Byesville, Ohio and allegedly used as construction fill in the surrounding community. Cyprus Foote, which was the successor to

the prior owner of the plant, took over the investigation and began to identify and characterize slag that had potentially been used as fill.

In the midst of that process, two class action lawsuits were filed and consolidated, Strawsburg, et al. v. Metallurg, Inc., et al., Case No. C2-94-1069 consolidated with Malernee, et al. v. Cabot Corporation, Case No. C2-95-248, alleging various causes of action, primarily seeking injunctive relief related to the slag at issue. The lawsuits also sought monetary damages for property diminution and emotional injuries. No physical personal injury claims were filed in either lawsuit.

Early in the case, Lead Class Counsel and Cyprus Foote recognized early in the case that a great deal of uncertainty existed surrounding the allegations in the complaint without the benefit of an extensive scientific evaluation. Thus, a determination was made that settlement negotiations and information sharing served the interests of all concerned, including the class members, better than complex, arduous litigation. Indeed, the primary beneficiary of zealous litigation would have been the attorneys. Thus, the parties stipulated to a provisional settlement class and began negotiations.

Cyprus Foote has maintained from the beginning that no immediate health and safety risk existed from the slag in question. The investigation, from Cyprus Foote's perspective, was to identify any "long-term risk" associated with the slag. Lead Class Counsel, of course, was concerned with any current risk as well as any long-term risk associated with the slag. Regardless, the desire for

information and evaluation of the slag drove the settlement negotiations. After approximately one year of negotiations and investigation of the slag, the parties had sufficient information to negotiate a fair and reasonable settlement.

The settlement negotiations have now concluded successfully. This Memorandum of Support is the Lead Class Counsel's to the consolidated class action and Cyprus Foote's joint request for preliminary approval of: (1) the Settlement;¹ (2) provisional settlement class certification; (3) the notice process to the plaintiff class as set forth in the MOU; and (4) a schedule for a formal fairness hearing pursuant to Fed. R. Civ. Pro. 23(e).

A. Factual Background

The Shieldalloy plant that is at the center of this lawsuit is a ferro alloy manufacturing plant. It has operated from approximately 1953 to the present time. Over that time, various alloys were produced at the plant and slag was created from alloy

¹Cyprus Foote agrees solely for the purposes of the Settlement and its implementation that Civil Action No. C2-94-1069, consolidated with Civil Action No. C2-95-248, shall proceed as class actions pursuant to Federal Rules of Civil Procedure 23(b)(1)(A) and Federal Rule of Civil Procedure 23(b)(2). (Exh. 1, p. 1.) Cyprus Foote has not admitted that it has engaged in any wrongful or culpable conduct or that any person has sustained any damage or loss by reason of any of the allegations made in this consolidated lawsuit. (Exh. 1, p. 1.) Obviously, plaintiffs disagree and contend that they could prove the allegations in their complaint. Notwithstanding, Cyprus Foote and plaintiffs have agreed to enter this Settlement solely in order to put to rest all controversy and avoid further expense and protracted costly litigation. Id. Nothing contained in this Motion or the MOU may be used or construed as an admission of any kind. This memorandum shall not be offered or received as evidence in any proceeding or any court or other tribunal, civil or administrative, as an admission or concession of wrongdoing of any nature of any kind for any purpose on the part of Cyprus Foote or as an admission or concession of any kind by plaintiffs.

production. The use, content, responsibility for, and ultimate disposition of the co-product slag from the plant which was utilized off-site is the focus of this consolidated lawsuit.

The alloy process, while not uniform, over its approximately 43 years of operation, consistently created slag as a product of extracting metal alloys from ores. Some of this slag was utilized by various contractors and individuals for building and construction materials, principally driveways, in and around Guernsey County, Ohio.

Cyprus Foote contends that the slag's principal use was for driveway gravel, and that most of the slag leaving the site for off-site use left between 1982 and 1987. Cyprus Foote contends that it knows this because prior to 1982, the slag produced by the production process was not conducive for use off-site inasmuch as it was produced in large slag "buttons" and was not easily amenable to crushing. Still, individuals in the community do allege that they received slag prior to 1982 for use on their driveways or for fill. Plaintiffs contend and certain individuals allege that they received slag for use in and around the foundation of their homes.

Undoubtedly, some people have used pre-1982 slag for building purposes, as plaintiffs allege. Slag is a popular building material and Guernsey County the situs of this dispute, has a history of slag use from a variety of plants, including: Wheeling-Pittsburgh Steel Mill, 500 Main Street, Martin's Ferry, Ohio; Wheeling-Pittsburgh Steel Mill (owned by Standard Slag Co., Youngstown, Ohio and distributed in the Cambridge, Ohio area by Carter Lumber), Mingo Junction, Ohio; Satra Concentrates, Inc.,

Mingo Junction, Ohio; International Mill Service, Weirton, West Virginia; Elkem Metals, Marietta, Ohio; Sharon Stone No. 2, Marietta, Ohio; Ohio FerAlloy, Philo, Ohio; Interlake Alloy Plant, Beverly, Ohio; and Beverly Slag Company, Beverly, Ohio. It is Cyprus Foote's contention that most of the slag that is in use in the community came from one of these other sources. Plaintiffs dispute this contention. Were this case to go to trial, this would be a hotly contested issue.

Foote Mineral Company, Cyprus Foote's predecessor, owned the Cambridge plant until May 13, 1987. Shieldalloy Corporation purchased the Cambridge plant from Foote Mineral Company, on May 13, 1987. Consequently, no one who received slag from the plant subsequent to May 13, 1987 is part of this settlement with Cyprus Foote.

Not surprisingly, the location and characterization of slag has required a complex and time-consuming investigation and assessment. Cyprus Foote, under the watchful eyes of the NRC, and Lead Class Counsel, and their technical teams, each have spent a tremendous amount of money and resources to evaluate the slag and address community concerns. While the issues confronting the lawyers in this case have been complex legally, the foundation for this settlement is the scientific investigation and evaluation of the slag and its potential impact on human health and the environment.

Cyprus Foote contends that the slag at issue does not pose a health and safety risk to residents. This is due to the fact that low levels of radiation (in most instances below

background) are at issue and the radioactive elements of concern are held tightly in the slag. Lead Class Counsel does not agree with Cyprus Foote's contention in this regard. Lead Class Counsel asserts that contrary evidence is available and can be argued to a jury.

B. Procedural Background

On November 7, 1994, a class action complaint, Strawsburg v. Metallurg, Inc., et al., Case No. C2-94-1069 ("Strawsburg class action"), was filed before this Court alleging that slag produced at the Shieldalloy Metallurgical plant ("Shieldalloy plant") located in Byesville, Ohio damaged the plaintiff class. Another class action, based upon virtually the same operative facts, was filed before this Court on March 6, 1995. That action was captioned Malernee, et al. v. Cabot Corporation, et al., Case No. C2-95-248 (S.D. Ohio 1995) ("Malernee class action"). Both lawsuits include claims for property damage, emotional distress, fear of cancer, and both cases have sought injunctive and monetary relief, including medical monitoring. Neither lawsuit alleges a claim for actual physical personal injury.

Metallurg, Inc., Shieldalloy Metallurgical Corporation, Cyprus Foote Mineral Company, and Foote Mineral Company, were named as defendants in the Strawsburg class action. Cabot Corporation, Cyprus Amax Minerals Company, Cyprus Foote Mineral Company, and Newmont Mining Corporation were named as defendants in the Malernee class action.

In September, 1994, defendants Shieldalloy Metallurgical Corporation ("Shieldalloy") and Metallurg, Inc. filed for Chapter

11 reorganization in the United States Bankruptcy Court for the Southern District of New York. Consequently, all litigation involving defendants Shieldalloy and Metallurg are subject to the automatic stay provided for by 11 U.S.C. §362(a). See Preliminary Pretrial Order, Strawsburg v. Metallurg, Inc., et al., dated March 10, 1995.

Defendant Cyprus Amax Minerals Company was dismissed from the consolidated actions for lack of personal jurisdiction. See Opinion and Order, Malernee, et al. v. Cabot Corporation, et al., dated Sept. 20, 1995. Defendants Cabot Corporation and Newmont Mining Corporation were voluntarily dismissed without prejudice from the Malernee class action.

On April 21, 1995, Cyprus Foote and Class Counsel in the Strawsburg class action stipulated to a provisional class for settlement purposes only pursuant to Fed. R. Civ. Pro. 23(b)(1)(A) and 23(b)(2). This Court approved that stipulation by order dated April 21, 1995. (Exh. 2.) This enabled Cyprus Foote to negotiate with Court-appointed Lead Class Counsel, and afforded the class appropriate representation.

On June 19, 1995, the Strawsburg class action was consolidated into the Malernee class action without objection by any party or their counsel. (Exh. 3.) At that time, all plaintiffs' counsel agreed to a stay of the litigation pending settlement discussions.²

²Throughout this case, Lead Class Counsel has been Alexander, Rapazzini & Graham. That law firm filed the Strawsburg class action. The Ulmer & Berne law firm filed the Malernee class
(continued...)

At the last status conference before Magistrate King on April 25, 1996, and again at the settlement conference before Magistrate Abel on May 10, 1996, Associate Class Counsel continually took the position that his clients have somehow been "frozen out" of this settlement. In light of Mr. Bell's out of the blue contention at the eleventh hour that he was somehow frozen out of the settlement process and that he has been opposed to the process from the beginning, some procedural history in this regard is warranted.

The development of this class action litigation and the parties' efforts at settlement are marred by a history of Associate Class Counsel, Steven Bell of Ulmer & Berne, attempting to gain control of the plaintiff class. Ulmer & Berne has been vying for control of the plaintiff class since the Malernee class action was filed four months after the initial class action was filed by Lead Class Counsel. Ulmer & Berne's motive in this case is clearly demonstrated by a series of maneuvers designed for the sole purpose of disruption of the settlement process. Mr. Bell's conduct in this case includes the filing of a baseless and frivolous disciplinary action in Ohio against Lead Class Counsel, Richard Alexander; the filing of an ill-conceived petition for writ of mandamus in the Sixth Circuit Court of Appeals against the Honorable Judge Smith; non-cooperation on issues designed to

²(...continued)
action. Steven Bell, Associate Class Counsel, Mark Rapazzini and Beth Graham, Lead Class Counselors, and Robert Casarona defense counsel for Cyprus Foote were all present at the June 19, 1995 status conference at which a stay of the litigation pending settlement discussions was agreed to by the parties.

benefit his individual clients such as a staunch refusal to provide property access to evaluate slag; refusal to let Lead Class Counsel communicate with "his clients"; and, outright refusal, despite the requests of both the Court and the other parties, to communicate the nature and extent of his objections to and/or demands of "his clients."

Following the filing of his clients' class action complaint on March 6, 1995, Mr. Bell moved for class certification under Rule 23, including Rules 23(b)(1)(A) and 23(b)(2). See Motion for Class Certification, Malernee, et al. v. Cabot Corporation, et al., dated March 6, 1995.

On Friday, May 5, 1995, however, after Lead Class Counsel was stipulated to in the Strawsburg class action, Mr. Bell changed his mind and indicated to the Court in a telephonic status conference that a Rule 23(b)(2) class would prejudice "his clients." During that conference, Cyprus Foote made clear that it was concerned with having to respond to lawyers purporting to represent parties that were already represented by Lead Class Counsel. Such work is not only duplicative and costly, but may be inconsistent with the Lead Class Counsel designation and the negotiation process underway. Magistrate Judge Abel indicated that those issues should be presented and argued after the two lawsuits were consolidated. Interestingly, Magistrate Judge Abel noted in his Discovery Conference Order at that time, "Although the proposed class should not be burdened with unnecessary attorney's fees, the fundamental issue of whether the case should proceed as a Rule 23(b)(2) or Rule 23(b)(3) class needs to be resolved promptly."

See Discovery Conference Order, Malernee, et al. v. Cabot Corporation, et al., dated May 5, 1995.

Instead of waiting for the cases' consolidation to address this issue as suggested by Magistrate Abel, the following Monday, on May 8, 1995, Mr. Bell filed a Writ of Mandamus against Honorable Judge Smith in the Sixth Circuit Court of Appeals seeking to direct this Court to vacate its order conditionally certifying a settlement class. On June 2, 1995, the Writ of Mandamus was denied. (Exh. 4.)

Twelve days later, on Wednesday, June 14, 1995, Mr. Bell once again reversed directions, and this time he represented to the Court during its status conference that he was amenable to the settlement process already underway. Mr. Bell agreed and consented, without interposing any objections, that the two class action lawsuits should be consolidated for all purposes, and that the parties should negotiate the terms of a settlement and submit a notice to the plaintiff class by no later than June 26, 1995. (Exh. 3.)

Indeed, Associate Class Counsel stated, "[P]laintiffs believe that all of their energies should now be directed towards the negotiation of a settlement of this matter within the shortest possible time. (Exh. 5.) He further stated that, "the devotion of further resources to the litigation of this action is inconsistent with the agreement of [plaintiffs' counsel] to attempt to conclude

a negotiated settlement." (Exh. 5.)³ Associate Class Counsel was obviously aware that the provisional settlement class was a mandatory non-opt out class when he stated his clients' position.

Subsequently, on Monday, July 10, 1995, the parties filed a court-ordered and approved Notice of Class Action and Appointment of Class Counsel for Settlement Negotiations with Cyprus Foote Mineral Company. (Exh. 6.) This document notified the class members, among other things:

1. that the two lawsuits were consolidated;
2. that the Alexander Law Firm was designated as Lead Class Counsel and Ulmer & Berne was designated as Associate Class Counsel, although class members were free to retain and pay for counsel of their choice;
3. of the nature and scope of the mandatory settlement class;
4. that the parties would attempt to negotiate a settlement; and
5. that settlement expenses must be approved by the Court as fair and reasonable.

(Exh. 6.) Ulmer & Berne was invited to participate in the drafting of this notice, and never once objected in any fashion to this

³In a letter to Magistrate Judge Norah M. King, U.S. District Court, S.D. Ohio from Steven D. Bell, Associate Class Counsel, dated September 21, 1995, Associate Class Counsel stated:

"the consolidation of the Malernee case with the Strawburg case, and the consequent designation of the Alexander Law Firm as lead class counsel in the resulting consolidated case (with Ulmer & Berne continuing to serve as class counsel) has been discussed at length. The class representatives in the Malernee action believe that consolidation of these matters is in the best interest of the class which they represent, and the class representatives consent to such consolidation."

notice and the notice was published in the Columbus Dispatch for 30 days.

Throughout the remainder of the summer and fall seasons, the parties' retained consultants who worked diligently to complete field work designed to identify the nature and scope of any potential problem posed by the slag in the local community and on the properties of the identified class as alleged by the plaintiffs' claims. On behalf of the plaintiff class, Alexander, Rapazzini & Graham shouldered all costs and expenses.

By September 20, 1995, through the efforts of the Cyprus Foote community awareness and outreach programs (described in greater detail below), and the efforts of the Alexander firm, 111 properties had been identified as potentially containing slag from the Shieldalloy plant. (Exh. 7.)

Following this extensive investment of time and resources by the parties in technical and evaluative work, Lead Class Counsel and counsel for Cyprus Foote turned their attention to negotiations aimed at narrowing the technical and legal issues in dispute and identifying areas of compromise and agreement. Associate Class Counsel, Steven D. Bell, was never prevented from participating in the development of the class plaintiffs' settlement position and was encouraged to communicate his clients' concerns and demands. In fact, that was his obligation to his clients. However, Mr. Bell refused to participate in any fashion in the class negotiations. In February, 1996, however, he transmitted a letter to counsel for Cyprus Foote outlining areas that concerned the Malernees, in an

effort to individually settle their case outside the class context.⁴ (Exh. 8.) Mr. Bell's only stated concerns at that time were with respect to the Malernees. Mr. Bell's concerns as articulated by him, were taken into account by Lead Class Counsel during the settlement negotiations.

By April 5, 1996, Lead Class Counsel and Cyprus Foote indicated to the Court that they had reached an agreement in principle to settle the issues in the consolidated lawsuits.

On April 26, 1996, even though Associate Class Counsel had obviously consented to the settlement process that he had been part of since June 14, 1995, Mr. Bell adamantly refused to present the MOU to "his clients" for their approval or disapproval, stating that he would not do so until the MOU was "final."⁵

Ulmer & Berne has since stated that it is opposed to the settlement and that its primary objection is that the proposed class to be certified for this settlement does not permit opt outs pursuant to Fed. R. Civ. Pro. 23(b)(3). Meanwhile, Cyprus Foote has offered to attempt to address the Malernees' concerns, individually, but Mr. Bell has refused, contrary to his clients' interests, to convey a demand to Cyprus Foote. Cyprus Foote is unaware if Mr. Bell has conveyed Cyprus Foote's desire to attempt

⁴It should be noted that Mr. Bell has recently taken the position that the Malernees are representing the class and, thus, cannot state their individual settlement position out of regard for the class. Apparently, that was not the case in February, only three months ago.

⁵At that time, Cyprus Foote had notified Mr. Bell that the scope of the release for the settlement was in dispute.

to address the Malernees' concerns with the MOU (whatever they may be) to the Malernees.

On June 6, 1996, Mr. Bell filed a misplaced Motion to Stay Preliminary Approval of the Proposed Settlement. Cyprus Foote shall, simultaneously with this Motion for Preliminary Approval, file a response to that Motion.

C. Radiation And The Hypothetical Future Dose

Radiation is a fact of life. Almost everything, including people, contain radioactive material. It occurs naturally and can be created artificially. Radiation of natural origin pervades the environment. Naturally-occurring radioactive material ("NORM") consists of a variety of substances that occur routinely in nature. "Background radiation" is the radiation that is emitted from materials in and on the earth and in space. Examples of materials regularly containing radioactivity from NORM are animal feed supplements, fertilizers, soil conditioners, construction fill, wallboard and foundation gravel. In the instance case, some of the ores originally removed from the earth contained NORM. As a result, certain slag produced in the plant's production process contained NORM. This occurrence is common.

Critical to this case is the potential "radiation dose" that any particular plaintiff may have been exposed to from the slag. The amount of radiation to which a person has been exposed during a specific unit of time is that person's dose. There is considerable controversy regarding the specific amount and type of risk involved for different levels of radiation dose. The determination of whether any radiation has been discharged, the

calculation of radiation doses received and the monitoring of their effects, if any, on people are extremely complex and difficult undertakings. Both plaintiffs' and Cyprus Foote's experts, experienced in this area, have studied these issues in the context of this case in great detail.

Potential radiation doses from radionuclides in soil, or material such as slag, are proportional to the concentration of each radionuclide, with the proportionality depending on the exposure scenario, pathways and parameters. The model widely accepted to determine radionuclide concentrations in soil and the associated dose is a computer code developed by the U.S. Department of Energy to derive site-specific soil guidelines. It is known as RESRAD. The use of RESRAD requires that a hypothetical exposure scenario is utilized.

In the instant case, Cyprus Foote used the highly conservative exposure scenario of the adult resident farmer. Under this scenario, it is assumed that in the future, all properties will become farms. Potential exposure pathways assumed for purposes of this scenario include: external radiation exposure from slag on the ground surface; inhalation of resuspended dust; inhalation of radon and radon progeny; ingestion of food crops; ingestion of meat and milk; incidental ingestion of slag; ingestion of drinking water; and ingestion of fish. Cyprus Foote's position is that the relevance and applicability of many of these exposure pathways to slag is highly questionable and speculative. Plaintiffs believe this highly conservative model is appropriate and are confident that the analysis of the exposure pathways is

protective of this community. Cyprus Foote, for the purposes of this case, has made the extremely conservative assumption of potential exposure from all of these pathways. Thus, the "radiation doses" generated by the RESRAD model in this case are an over-estimation as far as Cyprus Foote is concerned. Plaintiffs believe they are appropriate.

In addition to the exposure pathways mentioned above, conservative exposure parameters were also determined for each exposure pathway. Examples of some exposure parameters used in this instance are as follows:

1. radiation doses were modeled for a period of 1,000 years, with no source dilution or decrease in source term by erosion;
2. slag particles were assumed to be resuspended by wind erosion followed by inhalation and deposition into crops and forage with no decrease in the amount of slag; and
3. slag was assumed to constitute the entirety of soil in which crops and forage were grown.

Cyprus Foote and Lead Class Counsel have taken the conservative scientific evaluation done by Cyprus Foote and the NRC, including the RESRAD models, and utilized it as the foundation for the proposed settlement pending before this Court for preliminary approval.

The highly complex nature of the science involved, the unique difficulties inherent in allegations historically impacted by potentially 40 years of plant operation, and the procedural complexities of this lawsuit have made the negotiation of this settlement arduous. However, as set forth below, Lead Class

Counsel and Cyprus Foote have fashioned a fair, adequate and reasonable settlement for all members of the class.

D. Cyprus Foote Has Conducted Extensive Investigation And Produced The Investigative Results To The Class Plaintiffs

Cyprus Foote, under close scrutiny by a variety of regulators and Lead Class Counsel, has engaged in extensive investigative efforts over approximately two years. These efforts have been made to identify, investigate, and assess the potential radiological effects of that slag, believed to originate from the Shieldalloy plant, now in and around the Guernsey County area, that is the focal point of the Class Plaintiffs' allegations.

The objective of the Cyprus Foote response efforts has been twofold: first to evaluate the potential radiological dose associated with the slag at issue, and then to take appropriate action where warranted.

Cyprus Foote's investigative efforts began with the "Cambridge Information Project" ("CIP"). The CIP began operation on November 1, 1994. The CIP was developed to work with federal health, safety and environmental officials to collect information about slag in the Guernsey County community. In this regard, a local "hotline" phone number was placed into service for people to call and provide information regarding slag believed to be from the Shieldalloy plant.

The CIP included vigorous efforts to identify potential sites where slag from the Shieldalloy plant may be located, including the properties owned by members of the Plaintiff Class. The CIP and the efforts of Lead Class Counsel can be credited to a

large degree for the community's widespread knowledge of this lawsuit and the concerns raised with respect to the slag. Efforts by Lead Class Counsel have also been significant in this regard. Lead Class Counsel personally contacted every citizen who expressed concerns about the slag.

Cyprus Foote instituted newspaper publication seeking identification of slag locations in the Daily Jeffersonian on November 2 and 13, 1994, March 7 and 10, 1995, April 7 and 10, 1995, May 9, 1995. Publication was also placed in the Columbus Dispatch on March 7, and 13, 1995. Cyprus Foote also ran an advertisement seeking information with respect to slag locations from the Shieldalloy plant in the Daily Jeffersonian four additional times between November 14, 1994 and December 5, 1994 and four additional times in JeffPlus in November/December, 1994. Finally, the Court approved a joint notice of provisional settlement class which ran in the Columbus Dispatch for 30 days in the fall of 1995.

Additionally, Cyprus Foote ran 54 separate radio spots on 3 radio stations with diverse formats during the week of November 15, 1994 seeking information on slag location.

Community meetings were held throughout the past two years and Lead Class Counsel worked cooperatively with community activists. In addition, the NRC has held at least 2 public meetings on November 1, 1994 and December 5, 1995 and Lead Class Counsel and Associate Class Counsel have placed their own respective notices in the newspaper as well.

Cyprus Foote has also posted notice to employees at the Shieldalloy plant to identify those employees that may have taken slag for off-site use.

Cyprus Foote also initiated a "radon response program" in and around Guernsey County. This program was installed to address public concern that existed and it was instituted despite the fact that studies by the United States Environmental Protection Agency ("U.S. EPA") and Ohio Department of Health (1989) indicate the presence of elevated levels of naturally occurring radon (a decay product of radium 226) throughout central Ohio, including Guernsey County. This program generated numerous inquiries to Lead Class Counsel which were addressed by Lead Class Counsel.

Studies by Cyprus Foote, approved by the NRC, indicate that the slag does not emanate radon (i.e., any radon in the slag is physically bound up in the slag). Plaintiffs do not offer an opinion on this, but Cyprus Foote has pointed out that there is no correlation between properties where slag is located around the house foundation and radon levels. To the extent that any elevated levels of radon do exist, Cyprus Foote asserts they are caused by naturally occurring radium 226 in the native soils of the region. Plaintiffs do not necessarily agree.

Nevertheless, Cyprus Foote was proactive in its community response and provided for a program to address community fears and issues raised in this lawsuit. As will be set forth below, Lead Class Counsel insisted as part of this settlement that these perceived fears continue to be addressed and they have been in the

proposed Settlement. (See Exh. 1.) Lead Class Counsel insisted on further field testing and studies as part of the settlement.

Of all the homes tested pursuant to Cyprus Foote's radon response program, five homeowners have had radon measurements indicating radon above the U.S. EPA action level. Three homes received radon mitigation systems while this lawsuit has been pending. Two property owners have refused to permit the mitigation system installation.

The major segment of Cyprus Foote's field investigation activities were initiated on May 9, 1995. Pre-field activities included securing access agreements from property owners and contracting and scheduling a laboratory. By May 24, 1995, sixty properties had been evaluated by Cyprus Foote in what has become known as the "Phase II investigation." This brought the total number of residential properties evaluated by Cyprus Foote and the NRC's independent contractor to 100.

By December 6, 1995, Cyprus Foote had identified 124 residential properties as potentially containing slag from the Shieldalloy plant. Many of these people simply indicated a "concern" that slag may be from the plant, while others clearly confused slag from the plant with slag from other sources. Additionally, some of the properties identified received their slag subsequent to May 13, 1987, according to statements made by the property owners.

II. TERMS AND PROVISIONS OF THE PROPOSED SETTLEMENT

A. General Description Of The Settlement

The settlement set forth in the attached MOU is the product of extensive scientific investigation and study. It is also the product of Lead Class Counsel and Cyprus Foote's desire to allow the science to guide the compromises made with respect to the outcome of this litigation.

Generally, once the properties at issue were identified, they were separated into categories and the potential risks and perceived concerns associated with the particular category were examined. The hypothetical future dose of the sum of all radionuclides identified at each class member's property was calculated. This analysis, using the RESRAD model discussed earlier, was the principal tool used to create the subclasses set forth in the MOU.

The principal relief provided by this proposed Settlement is injunctive in nature. All class members shall have their property investigated and evaluated (a great many already have). Depending on the results of the investigation, including that investigation already completed, class members may receive remedial action. In addition, all class members are entitled to receive money damages incidental to the injunctive relief provided under the proposed Settlement.

B. Conditions Precedent To The Proposed Settlement

The terms and provisions of the proposed Settlement between Cyprus Foote and Class Plaintiffs are fully set forth in the MOU which is attached to this Memorandum as Exhibit 1. For purposes of evaluating this Settlement, however, it must be recognized that the essential terms of the Settlement require mandatory class certification as a necessary condition. Class certification is crucial to Cyprus Foote's ability and willingness to perform under the proposed Settlement.

The Settlement described herein is expressly based upon the following conditions accepted by Lead Class Counsel and Cyprus Foote:

1. It is believed and understood by the parties, after widespread notice to the affected communities, including court-approved notice published on July 10, 1995, that members of the Plaintiff Class as defined in this Settlement have been fully identified. Notwithstanding, Cyprus Foote has agreed to jointly provide with Class Plaintiffs' further notice as may be required by the Court. The residential properties that fall within the class are identified in attached Exhibit 1. Thus, the Settlement is expressly conditioned upon the provisional certification of a mandatory, non-opt out plaintiffs' class as that class is defined below and as that class had been identified to date. If the number of class members' properties increases by 10% or more above the number of properties identified in Exhibit 1 before the Settlement is given final approval, then Cyprus Foote, at its sole discretion, may terminate this proposed Settlement; and
2. This Honorable Court's determination that this Settlement is fair and reasonable pursuant to Federal Rule of Civil Procedure 23(e) and this Settlement be entered as a final judgment; and
3. The final exhaustion of any appeal or challenge asserted in any court or tribunal, objecting to any aspect of this Settlement, including, but not

limited to, the provisional certification of a mandatory plaintiffs' class for settlement purposes.

C. Proposed Settlement Class Definition

The Settlement class definition as set forth in the attached MOU and for which the Plaintiffs and Cyprus Foote jointly seek class certification, is:

1. All persons who own residential property or reside on residential property containing slag (whether or not subsequently removed) generated from production operations of Foote Mineral Company and its predecessors prior to May 13, 1987 at the plant currently owned by Shieldalloy Metallurgical Corporation located in Byesville, Ohio.
2. This Settlement expressly excludes all persons who received slag generated from production operations owned and/or operated by Shieldalloy Metallurgical Company and its affiliates, subsidiaries, predecessors and successors as well as any other company that is unaffiliated with Cyprus Foote Mineral Company. It is expressly acknowledged by the parties that Foote Mineral Company ceased ownership and operation of the plant in question on May 13, 1987.

(Exh. 1, p. 4-5.)

Plaintiffs and Cyprus Foote seek certification of a class pursuant to Federal Rules of Civil Procedure 23(b)(1)(A) and 23(b)(2) on the grounds that:

1. As a result of the injunctions agreed to, the prosecution of separate actions by individual members of the class, if they are allowed to "opt out" would create a risk of "inconsistent or varying adjudications with respect to individual members of the class . . . would establish incompatible standards of conduct" for Cyprus Foote, justifying Fed. R. Civ. Pro. 23(b)(1)(A) certification;
2. Cyprus Foote has, to date, refused to act on grounds generally applicable to all in the class, thereby making appropriate the settlement's final

injunctive relief with respect to the class as a whole, under Fed. R. Civ. Pro. 23(b)(2); and

3. The Settlement is fair, adequate, and reasonable and in the best interests of the class as a whole.

D. Release Claims

When the Court's ruling approving the Settlement becomes final and all appeals are fully exhausted, plaintiffs' class shall, by order of the Court on behalf of the class, release with prejudice, acquit and forever discharge defendant Cyprus Foote Mineral Company, its subsidiaries, affiliates, successors and assigns, and all past, present and future directors, shareholders, officers, agents and employees and all related and associated companies and their respective past, present and future directors, shareholders, officers, agents, employees, predecessors, successors and assigns from any and all actions, causes of action, claims, demands, losses and damages, compensatory, punitive and exemplary, of whatsoever kind or nature which plaintiffs' class had or now has or may hereafter have arising directly or indirectly from, out of or in any way related to the slag described in paragraph 5 of the MOU and including, but not limited to (a) claims for (i) fear of cancer, disease or of contracting any illness, injury, or impairment; (ii) increased risk of cancer, disease or of contracting any illness, injury, or impairment; (iii) mental injury or impairment, (iv) medical monitoring, (v) loss of consortium, and (vi) emotional distress, discomfort, injury or impairment, including the physical symptomology proximately caused thereby; (b) claims for compensatory, exemplary or punitive damages; (c) negligence, willful and reckless conduct, private nuisance, public

nuisance, property diminution, property damage, stigma, ultrahazardous activity, trespass, fraudulent concealment, breach of the implied warranty of merchantability, and breach of the implied warranty of fitness for particular purpose claims; (d) claims under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601, et seq.; and any claim for attorneys' fees, costs and expenses in connection with this lawsuit and the slag described in paragraph 5 of the MOU; provided, however, this release does not extinguish any currently unknown future individual claims for compensatory damages for latent physical injuries proximately caused by the slag described in paragraph 5 of the MOU that have not manifested themselves up to the effective date of the Settlement.

E. Settlement Approval Procedure

No action brought as a class action may be settled, compromised, or dismissed without Court approval. Fed. R. Civ. Pro. 23(e). Judicial experience with Rule 23 has led to defined procedures and specific criteria for settlement approval in class action settlements, described in the latest edition of the Manual for Complex Litigation 3d (1995), at Section §30.4.

The Manual 3d's settlement approval procedure comprises three distinct steps:

1. Preliminary approval of the proposed settlement at an informal hearing;
2. Dissemination of mailed and/or published notice of the settlements to all affected class members; and
3. A "formal fairness hearing," or final settlement approval hearing, at which class members may be heard regarding the settlement, and at which

evidence and argument concerning the fairness, adequacy, and reasonableness of the settlement is presented.

This procedure, which is commonly utilized by the federal district courts, and which is endorsed by the leading class action commentator (see 2 Newberg on Class Actions 3d (1992), §§11.22 et seq.), assures class members of the protection of procedural due process safeguards and enables the Court to fulfill its role as the guardian of class interests.

The Application before this Court includes requests that the Court grant preliminary approval to the Settlement, provisional settlement class certification, the mailing of the accompanying Class Action Settlement Notice under the notice dissemination program described in the MOU, and the scheduling of a formal fairness hearing. These are the basic rulings conventionally made at the informal preliminary settlement hearing. 2 Newberg, supra, §11.26. The authority of the courts to enter such an order is inherent in Fed. R. Civ. Pro. 16(b) and 23(d)(5).

Consistent with this procedure, Cyprus Foote and the Class Plaintiffs have agreed:

1. To move this Honorable Court to preliminarily approve the Settlement;
2. To move this Honorable Court to provisionally certify a settlement class pursuant to Fed. R. Civ. Pro. 23(b)(1)(A) and 23(b)(2).
3. To move this Honorable Court to order that notice be directed to class members advising them of the Settlement and advising them of their right to object and the date of this Court's fairness hearing pursuant to Federal Rule of Civil Procedure 23(e);

4. To provide best practicable notice to the Class Plaintiffs as approved by the Court. The parties believe first class United States mail is the best practicable notice in the instant case. In that regard, the following has been agreed to:
 - a. The notice to be mailed shall be jointly prepared by the parties and submitted to the Court for approval within 30 days of the Court's preliminary approval of the Settlement.
 - b. Lead Class Counsel, Richard Alexander, shall send out all court-approved notices and certify to the Court that all identified class members were mailed notice in accordance with this Settlement and Court approval.
 - c. Cyprus Foote agrees to pay all postage costs of the notice as described herein.

(Exh. 1, p. 7.)

The settlement notice shall, at a minimum, inform the class members of the existence and the terms of the proposed Settlement, of their right to comment in support or opposition to the Settlement, and of the date, time, and place of the formal fairness hearing, which they are invited to attend.

Those class members wishing to file objections to the Settlement must file those objections with the Court along with an explanation of each and every reason they object to the Settlement, including support for their objections. Any objections not made in accordance with this provision are deemed waived and shall not be a part of the record before the Court. (Exh. 1, p. 7-8.)

III. PROPOSED SETTLEMENT SUBCLASSES

A. Subclass 1

Subclass 1 shall include those residential property owners and occupants where the measured hypothetical future dose of radionuclides presents the greatest concern. Under the Settlement, Cyprus Foote agrees to purchase and/or remediate the properties containing slag owned by class members in Subclass 1 and to pay one lump sum total payment of \$40,000. Remediation is defined as the excavation and removal of slag from the property.

Cyprus Foote has also agreed to pay reasonable temporary living expenses while excavation of the slag occurs if remediation is performed in lieu of a purchase. In addition, if remediation is selected by Cyprus Foote, radon testing and radon mitigation as provided for in the MOU shall be instituted.

B. Subclass 2

Each property containing properly identified slag with a hypothetical future dose estimated by the RESRAD model greater than or equal to 50 mrem/yr and less than 100 mrem/yr are included in Subclass 2. Under the settlement, Cyprus Foote agrees to either purchase or remediate Subclass 2 members' properties and pay one lump sum total payment of \$20,000 to each family in Subclass 2. Again, Cyprus Foote agrees to pay reasonable temporary living expenses while excavation of the slag occurs. In addition, if remediation is selected by Cyprus Foote, radon testing and radon mitigation as applicable and as provided for in the MOU shall be instituted.

C. Subclass 3

Subclass 3 includes class members that own or reside on properties with slag located against or contiguous to their respective residential dwellings' living quarters foundation. Under the proposed Settlement, Cyprus Foote agrees to the following relief for Subclass 3 members:

1. completion of short-term radon testing in the home during "closed home conditions" if requested by the property owner by a licensed State of Ohio radon testing company in accordance with a specific procedure set forth in the MOU;
2. any homeowner with radon test results exceeding 4 pCi/l would be entitled to a radon mitigation system at Cyprus Foote's expense;
3. within 7 days of the installation of a radon mitigation system, if the test results still indicate radon exceeding 4 pCi/l in the home, Cyprus Foote would change the system as necessary to accomplish a reading below 4 pCi/l in the home;
4. the owner(s) of record of each property in Subclass 3 would be entitled to receive a lump sum of \$15,000 or 10% of the appraised value of their property.

D. Subclass 4

Subclass 4 shall include all class members who own property containing slag from the Shieldalloy plant where the hypothetical future dose is less than 50 mrem/yr. Each class member who is the property owner in Subclass 4 is entitled to one lump sum payment of \$5,000 after appropriate testing and evaluation. (Exh. 1, p. 17.)

E. Further Investigation And Evaluation Of Class Plaintiffs' Properties

Cyprus Foote agrees to evaluate class members' properties that have been identified but where testing has not yet been performed. There have been 21 properties identified in this group. The evaluation, testing and analysis to be done, including the use of the RESRAD model and the sum of the fractions approach, would be performed in substantial conformance to the previous testing, analysis, and evaluation done to date by Cyprus Foote. Under the terms of the Settlement, Lead Class Counsel's experts would be allowed the opportunity to participate in the testing and evaluation, subject to the previous sentence. (Exh. 1, p. 17-18.)

Once the evaluation is complete, a class member's property would then be appropriately placed into one of the subclasses and the class members would be entitled to the same relief provided to the other members of that subclass.

F. Provision Of Incidental Money Damages By Defendant Cyprus Foote

The proposed Settlement requires that within 30 days of Preliminary Approval of the Settlement, Cyprus Foote deliver to an interest-bearing account designated by the Court the sum of \$850,000.00. This sum represents money damages incidental to the injunctive relief provided herein payable to the Class Plaintiffs. Any interest earned or income earned on the fund shall become part of the fund. No money may be withdrawn from the fund until the Court has:

1. certified a mandatory, non-opt out plaintiffs' class;

2. approved the Settlement according to its terms; and
3. all appeals are exhausted.

G. Administration Of Funds

Upon the Court's approval of the Settlement, Cyprus Foote would be relieved of all further responsibility or obligation with respect to administration of the incidental monetary damages to be paid pursuant to the Settlement. As soon as practicable, the Court would select a "master" or a "trustee" who will determine the protocol for distribution of the fund to the Class Plaintiffs and to accomplish actual distribution of the fund to the class members. No funds would be distributed until the Court has certified the mandatory, non-opt out plaintiff class, entered a final order approving the settlement as fair and reasonable, and all appeals and challenges are finally exhausted.

Lead Class Counsel would act in an advisory capacity to the court-appointed "master" or "trustee" and assisting in the processing of claims and distribution of funds, and in any other administrative matter if requested by the Court. Under the Settlement, Cyprus Foote agrees to pay Lead Class Counsel reasonable attorney fees and costs associated with Lead Class Counsel's involvement with administration of the Settlement fund. All final decisions with respect to fund administration would be by the court-appointed "master" or "trustee".

H. Administrative Costs Of The Fund

The costs of administration of the fund shall be paid separately from the fund by Cyprus Foote by express written order of the Court.

I. Attorneys' Fees And Costs

Under the terms of the proposed Settlement, Cyprus Foote agrees to pay the reasonable attorney fees of Lead Class Counsel that have been approved as fair and reasonable by the Court. The plaintiffs' attorney fees have not and shall not be discussed until the Court has certified the mandatory, non-opt out class, entered a final order approving the settlement as fair and reasonable, and all appeals and challenges are finally exhausted. Cyprus Foote also agrees to pay for reasonable and proper costs and expenses, including the plaintiffs' reasonable expert fees, up to \$200,000.

J. Court Shall Retain Jurisdiction

Pursuant to the proposed Settlement, the parties agree that this Court shall retain jurisdiction over all matters related to this Settlement, including its enforcement and proper administration.

IV. CRITERIA FOR PRELIMINARY SETTLEMENT APPROVAL

The Manual 3d characterizes the preliminary approval stage as an "initial assessment" of the fairness of a proposed settlement made by the court on the basis of written submissions and informal presentation from the settling parties. The Manual 3d suggests that, in some cases, a hearing may be needed to inform the Court about the circumstances surrounding the negotiations and to

describe the settlement itself. Manual for Complex Litigation 3d (1995), §30.4.

These requirements have been fulfilled in the instant litigation by the earlier informal conferences at which this Court, through Magistrate Judge King and Magistrate Judge Abel, met with counsel for the parties and discussed the terms of the Settlement, the nature and scope of the injunctive relief and incidental money damages, and the procedural due process aspects of the proposed Settlement including the ramifications of a mandatory, non-opt out class, certified pursuant to Rule 23(b)(1)(A) and Rule 23(b)(2).

The parties believe that this submission to the Court of the proposed MOU and the accompanying supporting documentation enables the Court to make an informed preliminary determination on class certification, the class notice procedure requested, and the settlement. The Manual 3d summarizes the preliminary approval criteria as follows:

If the preliminary evaluation of the proposed settlement does not disclose grounds to doubt its fairness or other obvious deficiencies, such as unduly preferential treatment of class representatives or of segments of the class, or excessive compensation for attorneys, and appears to fall within the range of possible approval, the court should direct that notice under Rule 23(e) be given to the class members of a formal fairness hearing, at which arguments and evidence may be presented in support of and in opposition to the settlement. For economy, courts have in appropriate cases permitted the notice under Rule 23(c)(2) to be combined with the Rule 23(e) notice.

Manual 3d, supra, §30.41. (Emphasis supplied)

The purpose of the preliminary evaluation is to determine only whether the proposed Settlement is within the range of

possible approval (the "range of reasonableness") and thus whether notice to the Class of its terms and conditions, and the scheduling of a formal fairness hearing, will be worthwhile. See, 2 Newberg on Class Actions 3d (1992), §11.25 "Preliminary Court Approval"; Liebman v. J.W. Petersen Coal & Oil Co., 73 F.R.D. 531 (N.D. Ill. 1973). As set forth below, the scheduling of a formal fairness hearing is not only worthwhile, but it benefits the plaintiff class.

A. The Proposed Settlement Is The Product Of Serious, Informed, Non-Collusive Negotiations

Since late April of 1995, Cyprus Foote and Lead Class Counsel have engaged in extensive discussions, discovery, and arduous settlement negotiations, before they reached settlement, in principle, in March, 1996. There followed continued discussion and negotiation, together with efforts to document the settlement, which culminated, after several breakdowns in negotiations, in the proposed Settlement.

While this litigation has been unique in its joint efforts to gain information with respect to the slag at issue, it has been zealously guarded on both sides. Vigorous and zealous advocacy of all claims and defenses has occurred. In fact, Cyprus Foote resolutely denies any liability to the Class Plaintiffs, under any theory. On the other hand, class plaintiffs strenuously support their positions and believe they can prove Cyprus Foote's culpability. Both sides recognize, however, that the inherent risk of loss, tremendous expense, delay and uncertainties of trial appeal, and the limited resources available, present the danger

that either side might "win an empty victory." So, the parties submit that this proposed Settlement is in the best interests of all and is fair, adequate and reasonable.

B. The Settlement Is Fair To All Class Members

The parties reached the proposed Settlement after a great deal of scientific study was completed. Substantial and extensive discovery and technical evaluation has been conducted. Negotiating counsel are familiar with the respective legal theories of all claims and defenses, and the evidence supporting them. The parties, thus fully informed, were able to evaluate the benefits of settlement in lieu of trial.

Counsel has evaluated all legal and factual issues, and considered all alternatives in developing this proposed Settlement. A critical point in this evaluation is that the slag at issue does not present a health threat to the plaintiffs now or in their lifetimes. Nevertheless, Lead Class Counsel has vehemently fought against a proposed release that would extinguish the rights of individual class members to bring future personal injury lawsuits against Cyprus Foote. As a result, the settlement agreement proposed does not extinguish future personal injury claims that allegedly occur as a proximate cause of exposure to the slag from the Shieldalloy plant.

C. No Preferential Treatment Is Accorded Class Counsel

The Settlement was vigorously negotiated by Lead Class Counsel for the benefit of the class as a whole and by counsel for Cyprus Foote for the benefit of the company. Lead Class Counsel have agreed not to request attorney's fees at this preliminary

juncture in the proceedings and, while Cyprus Foote has agreed to pay Lead Class Counsel's reasonable attorney fees, said fees have only been discussed in the context of protecting any monies given to the class members from depletion. The amount has never been discussed nor negotiated. Cyprus Foote has not even agreed that it would not make an objection to the amount of fees ultimately sought by plaintiffs' counsel.

V. THE PROPOSED SETTLEMENT MEETS FEDERAL RULE OF CIVIL PROCEDURE 23(a)(1)-(4) FOR SETTLEMENT PURPOSES

A. Certification Of A Provisional Settlement Class Is Well Accepted

The parties to this consolidated lawsuit seek certification of a provisional class for settlement purposes only on a mandatory basis pursuant to Fed. R. Civ. Pro. 23(b)(1) and 23(b)(2). The MOU attached as Exhibit 1 provides that preliminary or final certification of a settlement class pursuant to the MOU shall not constitute or be construed as an admission on the part of the defendant that this action or any other action is appropriate for class treatment pursuant to Fed. R. Civ. Pro. 23 or any other law or rule. (Exh. 1.)

It is well settled that settling parties may seek certification of a plaintiff class, for settlement purposes, where the parties have reached a proposed settlement before any formal class certification ruling has been made. Day v. NLO, 864 F.Supp. 50 (S.D. Ohio 1994); Eronson, et al. v. Bd. of Educ. of the City Sch. Dist. of Cincinnati, et al., 604 F.Supp. 68, 73, cert. denied, 56 U.L.W. 3338; 2 Newberg on Class Actions 3d (1992), §§11.22; 11.27A. See also, Ahearn v. Fibreboard Corp., 1995 U.S. Dist.

LEXIS 11523 (E.D. Tex. 1995); South Carolina Nat'l Bank v. Stone, 725 F.Supp. 1419, 1428 (D.S.C. 1990); In re: A.H. Robins Co., Inc., 880 F.2d 709, cert. denied, 493 U.S. 959 (4th Cir. 1989).

As Newberg states:

before an initial class ruling, a proposed settlement may be effectuated by stipulation of the parties agreeing to a temporary settlement class for purposes of settlement only. Under such a stipulation, the defendant agrees to the entry of a ruling that the class be certified if the settlement is approved. If the settlement fails, however, the stipulation is withdrawn, and the defendant reserves the right to object to class certification de novo Approval of a classwide settlement invokes the requirements of Rule 23(e), which authorizes dismissals or compromises of class actions only on court approval and on such notice to the class as the court might direct.

2 Newberg, supra, §11.22 at p. 11-31.

The practice of settlement purpose certification has arisen in recognition of the policies inherent in Fed. R. Civ. Pro. 23(e), which requires court approval of all settlements and compromises made in cases commenced as class actions. Certification of classes is widely endorsed by the courts to encourage reasonable settlements because it assures the defendant that the release given will bind all interested parties, not just the named plaintiffs. In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-0149 (S.D. Ohio) (Sept. 8, 1986 order granting motion for class certification under Rule 23(b)(1)(A) which is intended to protect defendants from confronting conflicting standard of conduct imposed on them from multiple separate litigations); South Carolina Nat'l Bank v. Stone, 725 F.Supp. 1419, 1428 (D.S.C. 1990); In re: A.H. Robins Co., Inc., 880

F.2d 709, cert. denied, 493 U.S. 959 (4th Cir. 1989); In re: Beef Industry Antitrust Litigation, 607 F.2d 167, 177-78 (5th Cir. 1979); Mashburn v. National Healthcare, Inc., 684 F.Supp. 660, 665, n.4 (M.D. Ala. 1988). 2 Newberg, supra, §11.23.

As Professor Newberg has observed:

[I]t is altogether proper and consistent for a court to certify a class for settlement purposes, while it might have had more difficulty reaching this determination in a different context. Temporary settlement classes have proved to be quite useful in resolving major class action disputes. While their use may still be controversial, most courts have recognized their utility and have authorized the parties to seek to compromise their differences, including class action issues, through this means.

2 Newberg, supra, §11.27 at p. 432.

A provisional settlement class was certified in this case on April 21, 1995 to permit the parties the opportunity to negotiate this settlement. That certification lapsed on October 21, 1995. The parties now seek provisional certification for settlement purposes. If the settlement is approved as fair, and the Court finds the certification is proper at the 23(e) hearing, the class shall be certified and the settlement implemented.

As the leading scholar on class actions has noted, it is entirely proper to certify, as a settlement class, a group which might have difficulty obtaining certification in a non-settlement context. 2 Newberg on Class Actions 3d (1992), §§11.27 and 11.27A. In fact, many courts which have denied litigation classes have gone on to certify settlement classes. See, cases cited in Newberg, Id.

As Newberg observes:

When a court reviews a proposed settlement class that is requested to facilitate resolution of a class action controversy, Rule 23 class requirements are more readily satisfied in the settlement context, where the circumstances are less complex, than if they were being applied to certify a class action for litigation purposes. Class certification to facilitate to group litigation of related claims serves a different objective than certification of a settlement class designed to facilitate settlement of a class controversy.

Id. at §11.28.

B. The Plaintiff Class Meets The Prerequisites For Class Certification

"For purposes of determining class certification, the court must accept as true the factual allegations contained in the complaint and may consider reasonable inferences drawn from the facts before it at . . . [this] stage of the proceedings." Senter v. General Motors Corp., 532 F.2d 511, 523 (6th Cir.) (1977), cert. den., 429 U.S. 870 (1976); In re: Revco Securities Litigation, 142 F.R.D. 659, 662 (N.D. Ohio 1992).

Rule 23 of the Federal Rules of Civil Procedure sets forth the legal standard for class certification. Fed. R. Civ. Pro. 23. Rule 23(a) requires the following prerequisites for class certification:

1. the class is so numerous that joinder of all members is impracticable;
2. there are questions of law or fact common to the class;
3. the claims or defenses of the representative parties are typical of the claims or defenses of the class; and

4. the representative parties will fairly and adequately protect the interests of the class.

Fed. R. Civ. Pro. 23(a)(1)-(4).

Plaintiffs bear the burden of proving each of these requirements. Senter v. General Motors Corp., 532 F.2d 511, 522 (6th Cir.) cert. denied, 429 U.S. 870 (1976).

In a class action a class representative or representatives with typical claims can sue for the class when the question is of common or general interest to persons so numerous as to make it impracticable to bring them all before the court. Supreme Tribe of Ben Hur v. Cauble, 255 U.S. 356, 363-64 (1921). Where the class representatives are well chosen, the procedure affords a protection to the rights of the absent, "which would satisfy the requirements of due process" Hansberry v. Lee, 311 U.S. 32, 43 (1940). The typicality requirement is intended to assure that the representatives' claims are similar enough to those of the remaining class members, so that the representatives will adequately represent the class. See, General Tel. Co. v. Falcon, 457 U.S. 147, 157 (1982). Consequently, typicality, commonality, and adequate representation by class counsel and class representatives are the essential elements concerning due process for class plaintiffs. These criteria have been met in the instant case for provisional settlement class certification as more fully outlined below.

1. The Numerosity Requirement Is Met

The numerosity (and the impracticality of joinder) requirement of Rule 23(a)(1) is met in the instant litigation.

See, Senter v. General Motors Corp., 532 F.2d 511, 523 (6th Cir. 1976); Kasper Buick - GMC Truck, Inc., et al. v. General Motors, 1989 U.S. Dist. LEXIS 19009 (S.D. Ohio 1989). Although at present there is no final figure for the size of the class population, the parties have identified approximately 100 potential property owners not including their family members within the scope of the class. The established threshold for numerosity is approximately 40 or more class members. See, 1 Newberg on Class Actions 3d, §4.03. Courts have found that as a practical matter, the difficulty of individually joining all parties in a 100-member class makes class treatment superior. See also, e.g., In re: IteI Securities Litigation, 89 F.R.D. 104 (N.D. Cal. 1981). Consequently, the numerosity requirement is fulfilled in the case at bar.

2. The Commonality Requirement Is Met

Rule 23(a)(2) requires that there be questions of law or fact common to the class. However, Rule 23 does not require that all issues of law or fact be common. Rather, a single issue common to the proposed class is sufficient to satisfy the 23(a)(2) requirements. Day v. NLO, 144 F.R.D. 330, 333, rev'd on other grds., 5 F.3d 154 (6th Cir. 1992); Boggs v. Divested Atomic Corp., 141 F.R.D. 58 (S.D. Ohio 1991); In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-149 at p. 11 (S.D. Ohio) (Sept. 8, 1986). See also, Port Authority Police Benevolent Association v. Port Authority, 698 F.2d 150 (2d Cir. 1983); Stewart v. Winter, 669 F.2d 328, 335 (5th Cir. 1982). Generally, when the plaintiffs allege that the defendant has engaged in a course of conduct injuring the class, one or more of the elements of the cause of

action will be common to all individuals affected. In re: A.H. Robins Co., Inc., 880 F.2d 709, 737-738 (4th Cir.), cert. denied, 493 U.S. 959 (1989); 2 Newberg on Class Actions 3d § 3.10 (1992).

The requirements of Rule 23(a)(2) will be satisfied even if individual class members are required to show their particular right to recover. In re: Telectronics Pacing Sys., 164 F.R.D. 222 (S.D. Ohio 1995), citing to, Jennings Oil Co. v. Mobil Oil Corp., 80 F.R.D. 124, 129 (S.D. N.Y. 1978); sustain varying degrees of injury, Gordon v. Continental Airlines, 648 F.2d 1223 (9th Cir.) cert. denied, 460 U.S. 1074 (1981); or raise individual defenses against class plaintiffs. In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-0149 (S.D. Ohio) (Sept. 8, 1986) (Order Granting Motion for Class Certification Under Rule 23(b)(1)(A)). Consequently, the commonality test "is qualitative rather than quantitative, that is, there need be only a single issue common to all members of the class." 2 Newberg on Class Actions 3d § 3.10 (1992). In the instant lawsuit, all of the Class Plaintiffs commonly allege that the defendant engaged in a single, common course of conduct: it produced a slag at the Shieldalloy plant prior to May of 1987 and that this particular slag was disseminated to the class.

3. The Class Representatives Are Typical

The Sixth Circuit has stated that, if the representative was a member of the class at the time the suit was filed, his claim will be typical. Senter v. General Motors Corp., 532 F.2d 511, 525 (6th Cir. 1976). Addressing the typicality requirement, the Supreme Court has held that the named plaintiff must not only be "a

part of the same class but must also suffer the same injury." East Texas Motor Freight System, Inc. v. Rodriguez, 431 U.S. 395 (1977).

It follows, then, that typicality is satisfied if the representative plaintiff's cause of action arises from the same course of conduct, or events, as the other class members and if the representative plaintiffs' claim for relief is founded on the same legal theory. Senter, 532 F.2d at 525; Andre H. by Lula H. v. Ambach, 104 F.R.D. 606 (S.D. N.Y. 1985); Penn v. San Juan Hospital, Inc., 528 F.2d 1181 (10th Cir. 1975). Even if individual facts support each members' claims, typicality is usually met if the alleged unlawful conduct impacted both the named plaintiffs and putative class members. Griffin v. Burns, 431 F.Supp. 1361 (D.R.I. 1971) aff'd, 570 F.2d 1065 (1st Cir. 1978); Gerstle v. Continental Airlines, 50 F.R.D. 213, 219 (D. Col. 1970) aff'd 466 F.2d 1374 (10th Cir. 1972).

In a case similar to the instant litigation, the court in In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-0149 (S.D. Ohio) (Sept. 8, 1986) found that the representative plaintiffs and the putative class had injuries of the same type - property damage or emotional distress - as a result of facts common to the class. Specifically, the common facts included the defendants' operation of the Fernald plant and the discharge of radioactive materials into the surrounding area. Id. Additionally, the representatives and class members were advancing the same legal theories for the same type of relief. Id. Because the court also found that factual differences in individual claims would not destroy typicality the court had little difficulty in

finding that the named plaintiffs met the requirements that their claims be typical. *Id.* Similarly, the legal theories and claims for relief in the instant case are especially amenable to class treatment because they flow from claims of property damage and emotional distress allegedly caused by the slag from the Shieldalloy plant.

4. The Class Representatives Fairly And Adequately Represent All Class Members

The final prerequisite of Rule 23(a) insures that the representatives of the class will fairly and adequately represent the absent class members. Various courts addressing this issue have identified many factors to be considered in assessing the adequacy of the representation offered by the named plaintiffs in a class action. Chief among these are the absence of antagonism between the interests of the named plaintiffs and the interests of the other class members, the competence of counsel for the class, and the willingness of the named plaintiffs to vigorously prosecute the interests of the class. *Sosna v. Iowa*, 419 U.S. 393, 403 (1975); *Cross v. National Trust Life Insurance Company*, 553 F.2d 1026, 1031 (6th Cir. 1971). Fed. R. Civ. Pro. 23(a). This prerequisite is essential to due process, because a final judgment in a class action is binding on all class members. *Hansberry v. Lee*, 311 U.S. 32 (1940). See also, *Smith v. Babcock*, 19 F.3d 257, 264 n.13 (6th Cir. 1994).

Class representatives satisfy the adequacy requirement unless they have "an insufficient stake in the outcome or interests antagonistic to the unnamed members." *Jenkins v. Raymark*

Industries, Inc., 782 F.2d 468, 471-72 (5th Cir. 1986) ("adequacy" requirement looks at both class representatives and their counsel). "So long as all class members are united in asserting a common right," such as achieving the maximum possible recovery for the class, the class interests are not antagonistic for representation purposes." In re: Corrugated Container Antitrust Litigation, 643 F.2d 195, 208 (5th Cir.), cert. denied, CFS Continental, Inc. v. Adams Extract Co., 456 U.S. 498 (1982). (Emphasis added.)

In considering the adequacy of representation in the context of a class action, the Sixth Circuit has similarly found that Rule 23(a)(4) allows certification only if "the representative parties will fairly and adequately protect the interests of the class." In re: American Medical Systems, Inc., 75 F.3d 1069 (6th Cir. 1996). See also, Fed. R. Civ. Pro. 23(a); Hansberry v. Lee, 311 U.S. 32 (1940); Smith v. Babcock, 19 F.3d 257, 264 (6th Cir. 1994).

In Senter, supra, the Sixth Circuit articulated two criteria for determining adequacy of representation:

1. the representative must have common interests with unnamed members of the class; and,
2. it must appear that the representatives will vigorously prosecute the interests of the class through qualified counsel.

Senter, 532 F.2d at 525; Cross v. National Trust Life Ins. Co., 553 F.2d 1026, 1029, 1031 (6th Cir. 1977) (Rule 23(a)(4) tests "the experience and ability of counsel for the plaintiffs and whether there is any antagonism between the interests of the plaintiffs and other members of the class they seek to represent"). See also,

General Tel. Co. v. Falcon, 457 U.S. 147, 157 ("adequacy of representation requirement . . . also raises concerns about the competency of class counsel and conflicts of interest"). Based on these criteria, the adequate representation requirement overlaps with the typicality requirement because in the absence of typical claims, the class representative has no incentives to pursue the claims of the other class members. In re: American Medical Systems, Inc., 75 F.3d 1069, 1079 (6th Cir. 1996).

As such, the Sixth Circuit has found that the district court must make specific factual findings based on the pleadings and record before it as to each of the four criteria outlined under Rule 23(a), as well as the two criteria defined in Senter, supra. In re: American Medical Systems, Inc., 75 F.3d 1069, 1079 (6th Cir. 1996). These specific findings by the court may include:

1. the qualifications of plaintiff's counsel;
2. whether the lead named plaintiff or the other plaintiffs will "vigorously prosecute the interests of the class; and,
3. the suitability/competency of the class representative to serve as a class representative.

Id. See, e.g., Roundtree v. Cincinnati Bell, Inc., 90 F.R.D. 7, 10 (S.D. Ohio 1979).

In the instant case, the class representative in each subclass has common interests with unnamed members and the class representatives have zealously asserted their claims and have vigorously advanced the interests of the unnamed class members--despite Cyprus Foote's position that the class plaintiffs' allegations are unfounded. In addition, Lead Class Counsel has

vast experience in representing plaintiff classes in this type of litigation.

C. This Class Is Maintainable As A Mandatory, Non-Opt Out Class

In the instant case, Cyprus Foote and Lead Class Counsel seek, for settlement purposes only, to obtain certification of a class under Rule 23(b)(1) and 23(b)(2). A non-opt out mandatory class is properly certified for settlement purposes in this case.

1. A Non-Opt Out Class Is Maintainable Under Rule 23(b)(1)(A)

Rule 23(b)(1)(A) provides, in pertinent part:

(b) Class Actions Maintainable.

An action may be maintainable as a class action if the pre-requisites of subdivision (a) are satisfied, and in addition:

(1) the prosecution of separate actions by or against individual members of the class would create a risk of

(A) inconsistent or varying adjudications with respect to individual members of the class which would establish incompatible standards for the party opposing the class.

* * *

Fed. R. Civ. Pro. 23(b)(1)(A).

Federal Civil Rule 23(b)(1)(A) is intended to protect defendants from confronting conflicting standards of conduct imposed upon them through multiple separate litigations. See, e.g., In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-0149 (S.D. Ohio) (Sept. 8, 1986) (Order Granting Motion for Class Certification Under Rule 23(b)(1)(A)) (release of large amounts of radioactive uranium dust from the Fernald plant).

Unlike the criteria employed under Rule 23(b)(1)(B), the fact that some plaintiffs may be successful in their suits against a defendant while others may not is not a ground for invoking Rule 23(b)(1)(A). In re: Bendectin Prods. Liab. Litig., 749 F.2d 300, 305 (6th Cir. 1984), citing to, McDonnell Douglas Corp. v. United States District Court, 523 F.2d 1083, 1086 (9th Cir. 1975), cert. denied, 425 U.S. 911 (1976); In re: "Agent Orange" Product Liability Litigation, 100 F.R.D. 718, 724-25 (E.D.N.Y. 1983), aff'd, 818 F.2d 145, cert. denied, 484 U.S. 1004 (1988). See also, In re: Diamond Shamrock Chemicals Co., 725 F.2d 858 (2d Cir.), cert. denied, 465 U.S. 1067 (1984). Rule 23(b)(1)(A) is not intended to encompass situations in which many plaintiffs sue the same defendant with the attendant risk that some plaintiffs recover and others do not. In re: Bendectin Prods. Liab. Litig., 749 F.2d 300, 305 (6th Cir. 1984); McDonnell Douglas Corp. v. United States District Court, 523 F.2d 1083 (9th Cir. 1975), supra. Rather, separate litigation must create the risk of producing incompatible, not merely inconsistent, results. Bendectin, 749 F.2d at 305; In re: "Agent Orange" Product Liability Litigation, 100 F.R.D. 718 (E.D. N.Y. 1983).

In Bendectin, 749 F.2d at 305, the Sixth Circuit held that the district court had failed to demonstrate how inconsistent adjudications would result in incompatible standards. Thus, the Court vacated Rule 23(b)(1)(A) certification. Id. By contrast, separate litigation of plaintiff's claims here would place Cyprus Foote in jeopardy of directly confronting incompatible standards. For example, conflicting injunctive standards and requirements

could be imposed by ordered corrective action applicable to different class members' respective property. See, Boggs v. Divested Atomic Corp., 141 F.R.D. 58 (S.D. Ohio 1991).

The monetary relief provided in the settlement does not prevent a certification pursuant to Rule 23(b)(1)(A). Rule 23(b)(1)(A) certification is appropriate because the relief sought is a combination of both injunctive and monetary relief, although not primarily monetary relief. See, e.g., In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-0149 (S.D. Ohio) (Sept. 8, 1986) (Order Granting Motion for Class Certification Under Rule 23(b)(1)(A)), citing with approval to 1 Newberg on Class Actions 2d, § 4.08, at 285 (1985).

This Court in Fernald determined that the plaintiffs' demand for injunctive relief was aimed at correcting any environmental harm that had already occurred and from preventing any further harm to the plaintiffs located within a 5-mile radius of the Fernald facility. Id. The Fernald court found that:

[i]t is abundantly clear to this Court that inconsistent adjudications of defendants' liability could result potentially in incompatible standards regarding the type and extent of any ordered corrective or preventive relief. See In Re Jackson Lockdown/MCO Cases, 107 F.R.D. 703 (E.D. Mich. 1985). Furthermore, 23(b)(1)(A) certifications are particularly appropriate when other suits are likely, thus intensifying the risk of inconsistent adjudications. In Re Federal Skywalk Cases, 93 F.R.D. 415, 423 (W.D. Mo.), vac. on other grds, 680 F.2d 1175 (8th Cir.), cert. denied, 103 S.Ct. 342 (1982); 1 Newberg, *supra* § 4.08, at 285. Since litigation in this action already has been pursued by many other individuals, the risk of multiple suits is probable. (Other cases that have been consolidated in the instant litigation pursuant to the Preliminary Pretrial Order

In re: Fernald Litigation, Slip Opinion, Master File No. C-1-85-0149 (S.D. Ohio) (Sept. 8, 1986) (Order Granting Motion for Class Certification Under Rule 23(b)(1)(A)). As a result, this Court in Fernald certified a non-opt out Rule 23(b)(1)(A) class, refusing to consider a Rule 23(b)(3) class due to that category's provision for plaintiffs to opt out. Fernald, supra, ("[c]ertification under Rule 23(b)(3) with its 'opt-out' provisions would threaten this possibility"). See also, Boggs v. Divested Atomic Corp., 141 F.R.D. 58 (S.D. Ohio 1991); In re: Jackson Lockdown/MCO Cases, 107 F.R.D. 703, 711 (E.D. Mich. 1985); Reynolds v. National Football League, 584 F.2d 280 (8th Cir. 1978); Green v. Occidental Petroleum Corp., 541 F.2d 1335 (9th Cir. 1976).

If a non-opt out class were not certified, Cyprus Foote faces the probable risk of multiple suits from numerous plaintiffs, each involving complex, scientific evaluations, thereby creating the likelihood of inconsistent adjudications, resulting in incompatible standards by which Cyprus Foote may have to address the presence of off-site slag from the Shieldalloy facility. As a result, in order to effectuate a settlement, Cyprus Foote and Lead Class Counsel agree that certification of a mandatory, non-opt out class under Rule 23(b)(1)(A) is appropriate and required in the instant case to protect against the possibility of the imposition of inconsistent adjudications and incompatible corrective standards.

2. A Mandatory Non-Opt Out Class Is Maintainable Under Rule 23(b)(2)

The instant settlement class is also maintainable under Rule 23(b)(2).

Fed. R. Civ. Pro. 23(b)(2) provides, in pertinent part:

- (b) Class Actions Maintainable. An action may be maintained as a class action if the prerequisites of subdivision (a) are satisfied, and in addition:

* * *

- (2) the party opposing the class has acted or refused to act on grounds generally applicable to the class, thereby making appropriate final injunctive relief or corresponding declaratory relief with respect to the class as a whole;

Fed. R. Civ. Pro. 23(b)(2). Similar to Rule 23(b)(1)(A), a class certified pursuant to Rule 23(b)(2) is a non-opt out class. Laskey, et al. v. UAW, et al., 638 F.2d 954, 956 (6th Cir. 1981).

Courts in the Sixth Circuit have found that Rule 23(b)(2) classes are particularly appropriate where "the common claim is susceptible to a single proof and subject to a single injunctive remedy." Senter v. General Motors Corp., 532 F.2d 511, 525 (6th Cir.), cert. denied, 429 U.S. 870 (1976). See, e.g., Mitchell, et al. v. Dutton, et al., 865 F.2d 1268 (M.D. Tenn.), cert. denied, 490 U.S. 1048 (1989) (class wide discrimination); Alexander, et al. v. Aero Lodge No. 735, Int'l Ass'n of Machinists, 565 F.2d 1364, 1372 (6th Cir. 1977), cert. denied, 436 U.S. 946 (1978) (homogeneous class and discrimination of entire class based on race).

Certification under Rule 23(b)(2) is appropriate when a party opposing the class has acted in a consistent manner towards

the purported class members so that the defendant's actions are part of a pattern or practice of activity. Kasper Buick - GMC Truck, Inc., et al. v. General Motors, 1989 U.S. Dist. LEXIS 19009 (S.D. Ohio 1989) (Judge George C. Smith). Additionally, Rule 23(b)(2) is applicable when the court's equitable power is the primary form of relief sought. Consequently, "the subdivision does not extend to cases in which the appropriate final relief relates exclusively or predominantly to money damages." Fed. R. Civ. Pro. 23(b)(2) Advisory Committee's Note to 1966 Amendments. On the other hand, if the primary relief sought is injunctive, Rule 23(b)(2) certification is appropriate in spite of the presence of a class claim for money damages. See, supra, Alexander, et al. v. Aero Lodge No. 735, 565 F.2d 1364, 1372 (6th Cir. 1977).

A district court need not withhold approval of a settlement merely because some class members object to its terms. Dutton, et al., supra, at 1681. See also, Carson v. American Brands, Inc., 450 U.S. 79, 88 (1981) (in evaluating settlement draft court must consider and weigh the plaintiff's likelihood of success on the merits against the amount and the form of the relief offered in the settlement); Bronson, et al. v. Bd. of Educ. of the City Sch. Dist. of Cincinnati, et al., 604 F.Supp. 68, 73 (S.D. Ohio 1984), cert. denied, 56 U.S.L.W. 3338. Harris v. Pernsley, 654 F.Supp. 1042, 1050 (E.D. Pa.), aff'd, 820 F.2d 592 (3rd Cir.), cert. denied, 484 U.S. 947 (1987).

Similarly, the Manual for Complex Litigation and cases cited therein indicate that "the [best] view is that, if the conditions of (b)(1) or (b)(2) are met as well as those of (b)(3),

the court is not required to give notice or to permit members to opt out." Manual for Complex Litigation 3d (1995), § 30.14 see also; Penson v. Terminal Transport Co., 634 F.2d 989, 993 (5th Cir. 1981) (holding that a member of a class certified under Rule 23(b)(2) has no absolute right to opt out of the class, even where monetary relief is sought and is made available); see also, Reynolds v. National Football League, 584 F.2d 280, 283-84 (8th Cir. 1978) (holding that when there is a choice between (b)(1) and (b)(3) certification, generally it is better to proceed under (b)(1) in order to avoid inconsistent adjudication or a compromise of class interests); In re: Jackson Lockdown/MCO Cases, 107 F.R.D. 703, 711 (E.D. Mich. 1985) (finding mandatory class preferable to opt out in prison riot class action where there were claims for both monetary and injunctive relief). In applying these legal principles in Day v. NLO, 851 F.Supp. 869 (S.D. Ohio 1994), this Court concluded that certification under Rule 23(b)(2), without opportunity to opt out, was most appropriate. Id.

In the instant case, the principal relief sought and provided for in the Settlement is injunctive in nature. The plaintiffs sought and obtained identification, evaluation, notice and remedial action where appropriate for the class. Cyprus Foote has agreed to provide this relief in the context of this proposed Settlement. In addition, under the proposed Settlement, Cyprus agrees to pay incidental money damages related to the provision of injunctive relief. Consequently, the Court can and should certify this class for settlement purposes pursuant to Fed. R. Civ. Pro. 23(b)(2) as well as 23(b)(1).

VI. THE PROPOSED CLASS ACTION SETTLEMENT NOTICE SHOULD BE APPROVED FOR DISSEMINATION VIA DIRECT MAILING

The parties agree that best practicable notice of this settlement is accomplished through a direct mailing to members of the plaintiff class.

A direct mailing may be expeditiously accomplished because the class encompassed by the proposed Settlement has been ascertained after widespread notice and is comprised of residential property owners.

VII. THE FORMAL FAIRNESS HEARING SHOULD BE SCHEDULED

The last step in the settlement approval process is the "formal fairness hearing" recommended by the Manual for Complex Litigation 3d, §30.4, et seq. There, the Court may obtain all information relevant to its settlement evaluation. Proponents of the proposed Settlement can explain and describe its terms and conditions and offer argument and evidence in support of Settlement approval. Class members themselves, or their counsel, may be heard regarding the approval or disapproval of the proposed Settlement. If final approval is granted, the Settlement becomes binding on all plaintiff class members, and the claims of the class members against Cyprus Foote are released and dismissed via the entry of a final order and judgment by this Court.

The parties request that the Court conduct a fairness hearing in an effort to determine whether the proposed class settlement is ". . . fair, adequate, and reasonable" Clark Equip. Co. v. Int'l Union, Allied Indus. Workers of Am., AFL-CIO, 803 F.2d 878 (6th Cir.), 480 U.S. 934 (1987) quoting Officers for

Justice v. Civil Serv. Comm'n, 688 F.2d 615 (9th Cir. 1982), cert. denied, Byrd v. Civil Serv. Comm'n, 459 U.S. 1217 (1983); Bronson, et al. v. Bd. of Educ. of the City Sch. Dist. of Cincinnati, et al., 604 F.Supp. 68, 71 (S.D. Ohio 1984).

The trial court has discretion in determining the fairness of the proposed Settlement. Laskey, et al. v. UAW, et al., 638 F.2d 954, 957 (6th Cir. 1981). However, "the Courts' role in evaluating a private consensual agreement 'must be limited to the extent necessary to reach a reasoned judgment that the agreement is not the product of fraud or overreaching by, or collusion between, the negotiating parties and the settlement, taken as a whole, is fair, reasonable and adequate to all concerned.'" Clark Equip., supra, at 880, quoting Officers for Justice, 688 F.2d at 625 (9th Cir. 1982).

After the fairness hearing, the trial court has the power to take three actions when faced with the proposed Settlement:

1. to approve the proposed Settlement in whole;
2. to reject the proposed Settlement without recommendations for modification; or
3. to reject the proposed Settlement, but with suggestions and recommended changes.

Bronson, supra, at 73.

The burden of proving the fairness of the settlement rests with the proponents. Bowling, et al., v. Pfizer, Inc., et al., 143 F.R.D. 141 (S.D. Ohio), appeal dismissed, 995 F.2d 1066 (1992). However, an initial presumption of fairness exists if the settlement is recommended by class counsel after arms-length bargaining. Id.

A trial court may consider certain factors when it determines whether the proposed settlement is fair, adequate, and reasonable. First, the trial court may compare the strength of the plaintiff's case with the amount and form of relief offered by the settlement. Carson v. American Brands, 450 U.S. 79, 88 (1981) (commenting on how courts judge the fairness of a compromise); Williams v. Vukovich, 720 F.2d 909, 922 (6th Cir. 1983); Bronson, supra, at 73. Second, the trial court may search for the presence of collusion. Id. Stotts v. Memphis Fire Dep't, 679 F.2d 541 (6th Cir.), rev'd on other grds., 467 U.S. 561 (1984) (court can approve a settlement only after it determines that the settlement is the result of good faith, arms-length negotiations). Third, the trial court may consider carefully any objections raised by class members. Id. Fourth, the trial court may choose to analyze the amount and nature of discovery. Id. These factors should be considered as a whole to determine whether a proposed settlement is fair, adequate, and reasonable. Bowling, et al., v. Pfiizer, Inc., et al., 143 F.R.D. 141 (S.D. Ohio), appeal dismissed, 995 F.2d 1066 (1992).

In the instant case, while Lead Class Counsel believes that the allegations in the class plaintiffs' complaint are well-founded, Cyprus Foote's position is that causation, procedural and numerous legal issues related to the plaintiffs' claims cast doubt as to whether any of the plaintiffs' claims could ever prevail in this lawsuit. Outlined through the remainder of this section are some of Cyprus Foote's potential arguments should the proposed settlement fail.

In their complaint, the class plaintiffs allege damages for, inter alia, pain, suffering, discomfort, anxiety, fear, worries, stress, mental and emotional distress and fear of cancer. The plaintiffs have not, and have conceded that they cannot, allege actual physical injuries at this time as a result of the slag at issue in this litigation. Thus, the relief sought is primarily injunctive in nature and the monetary damages sought are incidental to that relief centering on property damage, inconvenience and fear.

In Paugh v. Hanks, the Ohio Supreme Court held that damages for emotional distress in the absence of physical injuries may be recovered in limited circumstances. See, Paugh v. Hanks, 6 Ohio St.3d 72 (1983). The Paugh court, in adopting evidentiary safeguards to prevent the potential abuses of the "infliction of emotional distress" tort, found that plaintiffs must prove that they suffered "serious emotional distress . . . which is both severe and debilitating." Id. at 78. Paugh, supra, 6 Ohio St.3d at 78, 80. (Emphasis added.)

In the recent decision of Day v. NLO, the "severe and debilitating" requirement articulated by the Paugh court was at issue. Day v. NLO, 851 F.Supp. 869 (S.D. Ohio 1994). Similar to the instant case, the Day case involved alleged radioactive exposures. Id.

The plaintiffs in that case argued that exposure to radioactivity was a physical injury in and of itself. Day v. NLO, supra, 851 F.Supp. at 875. The plaintiffs alleged that their physical exposure to radiation resulted in an increased risk of

disease, causing them emotional distress. Day v. NLO, supra, 851 F.Supp. at 877.

The Court stated that the mere exposure to a low dose of radiation is not equivalent to a physical injury. Day v. NLO, supra, 851 F.Supp. at 878, citing O'Conner v. Commonwealth Edison Co., 748 F.Supp. 672, 678 (C.D. Ill.), aff'd., 13 F.3d 1090 (7th Cir. 1994), cert. denied, 62 U.S.L.W. 3842; Bubash v. Philadelphia Elec. Co., 717 F.Supp. 297, 300 (M.D. Pa. 1989).

Thus, to constitute a physical injury, resulting in a "reasonable" standard for emotional distress, plaintiffs must show that they were exposed to overdoses of radiation. Day v. NLO, 851 F.Supp. 869, 882-883. The facts of this case do not support an excessive exposure to radiation.

No such exposures to excessive doses of radiation are present in the instant case. The potential exposures represented by the testing done to date indicate that they are not high enough to increase any plaintiff's risk of cancer.

A recent case similar to the instant case found that a plaintiff's fear of developing cancer, following his accidental exposure to radiation, was not reasonable and, thus, not compensable. In Hennessey v. Commonwealth Edison Co., the Court observed:

[I]f there was little or no chance of the plaintiff actually being injured, the plaintiff cannot have been endangered by the conduct. If the plaintiff was not endangered, then any resulting emotional distress, even if real, must be considered unreasonable, and hence unactionable.

* * *

[W]e acknowledge that . . . it has been widely reported and is widely accepted that increased exposure to radiation yields an increased risk of contracting cancer. To establish the reasonableness of this distress, however, Hennessy must show something more than a general awareness of the risk of contracting cancer as a result of exposure to radiation

Hennessy has come forward with no competent evidence to provide a reasonable basis for his apprehension that the level of internal contamination he received would be expected to have any significant adverse effect upon him in his lifetime

Hennessy v. Commonwealth Edison Co., 764 F.Supp. 495, 504, 505 (N.D. Ill. 1991).

Similarly, in Good Fund, Ltd.--1972 v. Church, the court noted that radioactive particles from a federal nuclear facility had been deposited on plaintiffs' neighboring lands, but concluded that the levels of contamination were so low that they "do not create a significant health hazard." Good Fund, Ltd.--1972 v. Church, 450 F.Supp. 519, 538 (D. Colo. 1982), rev'd on other grds. sub nom, McKay, et al. v. United States, et al., 703 F.2d 464 (10th Cir. 1983). Noting that the type of fear alleged by plaintiffs was "a public reaction which is conjectural, transitory and ephemeral," and that it was caused in part by the litigation itself, the court observed: "Unreasonable fear should not provide a basis for recovery." Id. at 534-35.

Long-term health concerns are equally absent based on the extensive investigation and analysis of the slag at issue in this case. The parties recognize that the long-term impact of the slag material is potentially important given the fact that radionuclides decay over time. However, "long-term" in this instance is far

greater than any of the plaintiffs' lifetimes. While the plaintiffs' retained expert in health physics recommends 1,000 years as an appropriate modeling period, Cyprus Foote does not believe that 1,000 years can be a basis for a claim for damages inasmuch as it is highly speculative. For that reason, the EPA Science Advisory Board has expressed concern with predicting the behavior of radionuclides 1,000 years into the future as being highly uncertain. See, Meeting of the Radiation Advisory Board of the U.S. EPA Science Advisory Board, May 25-26, 1995, Washington, D.C.

Cyprus Foote and Lead Class Counsel have also considered medical monitoring as a component of a potential settlement in good faith. The relevant data and analysis evaluated by experienced health physicists and radiologists with vast experience with cases of alleged exposure such as this, lead the parties to reach the conclusion that no medical monitoring is warranted. However, incidental money damages are being paid to those class members with the greatest hypothetical future dose. This money can be used by those individuals for medical monitoring if desired.

As this Court is aware, a claim for medical monitoring presents a question that is not entirely settled in Ohio. This Court recently considered the question of medical monitoring in Day v. NLO, 851 F.Supp. 869 (S.D. Ohio 1994). In that case, the Court noted that the plaintiffs would experience substantial difficulties concerning the state of the law regarding medical monitoring due to the difficulty of establishing the requisite elements for an award of medical monitoring. Day v. NLO, 851 F.Supp. 869, 882-883 (S.D.

Ohio 1994); see also, Potter v. Firestone Tire and Rubber Co., 863 P.2d 795, 823 (Cal. 1993); Hansen v. Mountain Fuel Supply Co., 858 P.2d 970, 977-78 (Utah 1993) (criteria used to establish the need for medical monitoring for toxic tort plaintiffs).

Generally, the class plaintiffs would have to prove that they had been overexposed to radiation proximately caused by the negligence of the defendant resulting in an increased risk of a serious disease, illness or injury and for which a medical test for early detection exists. Day v. NLO, 851 F.Supp. 869, 882 (S.D. Ohio 1994), citing to Hansen v. Mountain Fuel Supply Co., 858 P.2d 970, 979 (Utah 1993). Even if the plaintiffs could meet these proof requirements, the plaintiffs would have to show that any such early detection would be beneficial--meaning that a treatment exists that could alter the course of any such illness, that the test was one prescribed by a qualified physician according to applicable scientific principles, and that any compensation for medical expenses was reasonable and necessary. Id.

While Lead Class Counsel argued for, and Cyprus Foote in good faith considered medical monitoring, its need was not supportable by science. Fortunately, for all those impacted, the testing and evaluation demonstrates that there is no substantial increased risk of disease from the slag at issue in this lawsuit.

VIII. CONCLUSION

Representative Plaintiffs, by and through Lead Class Counsel, and Cyprus Foote, respectfully request that this Court commence its settlement approval process by granting: (1) preliminary approval to the proposed Settlement; (2) granting

provisional certification of a settlement class pursuant to Fed. R. Civ. Pro. 23(b)(1) and (b)(2); (3) approving the Class Action Settlement Notice process proposed; and (4) scheduling a formal fairness hearing in this matter.

Dated: June 14th, 1996.

Respectfully submitted,

ALEXANDER, RAPAZZINI & GRAHAM

Mark P. Rapazzini *Paul D. Jesse*
Richard Alexander, Esq.

Mark P. Rapazzini, Esq.
M. Elizabeth Graham, Esq.
55 Market Street, Suite 1080
San Jose, California 95128
(408) 289-1776

PER TELEPHONE AUTHORIZATION
Lead Class Counsel

CLIMACO, CLIMACO, SEMINATORE,
LEFKOWITZ & GAROFOLI CO., L.P.A.

Robert B. Casarona *Paul D. Jesse*
John R. Climaco (0011456)

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Trial Attorneys for Defendant
Cyprus Foote Minerals Company

CERTIFICATE OF SERVICE

I hereby certify that a true copy of the foregoing Motion for Preliminary Approval of Class Action Settlement and for Class Certification for Settlement Purposes together with Memorandum of Points and Authorities in Support of Preliminary Approval of Class Action Settlement and Certification of a Settlement Class Pursuant to Fed. R. Civ. Pro. 23(b)(1)(A) and 23(b)(2) have been sent by regular U.S. mail, postage prepaid, to Richard Alexander, Mark Rapazzini and M. Elizabeth Graham, 55 South Market Street, Suite 1080, San Jose, California 95113 and Steven D. Bell, Ulmer & Berne, Suite 900, Bond Court Building, Cleveland, Ohio 44114, this 14th day of June, 1996.

Robert B. Casarona */s/ Paul D. Jones*
Robert B. Casarona

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

STRAWSBURG, et al.,	)	CASE NO. C2-94-1069
	)	CONSOLIDATED WITH CASE
Plaintiffs,	)	NO. C2-95-248
)	
v.	)	JUDGE SMITH
)	
METALLURG, INC., et al.,	)	MAGISTRATE JUDGE KING
)	
Defendants.	)	MEMORANDUM OF UNDERSTANDING
	)	<u>OF SETTLEMENT</u>
)	

This Memorandum of Understanding of Settlement (hereinafter "MOU") sets forth the compromise and final settlement between the plaintiff class members of all claims asserted in the above-captioned cases (hereinafter referred to as the "settlement") once approved by the Court as a fair and reasonable settlement. It is agreed as follows:

1. Defendant Cyprus Foote Mineral Company (hereinafter "defendant") agrees solely for the purposes of the settlement and its implementation that Civil Action No. C2-94-1069, consolidated in whole with Civil Action No. C2-95-248, shall proceed as class actions pursuant to Federal Rules of Civil Procedure 23(b)(1) and (b)(2). If the settlement fails to be approved or otherwise fails to be consummated for any reason, including, but not limited to, a failure to be affirmed on appeal, as drafted herein and agreed,

then defendant retains all rights to contest and object to the maintenance of the consolidated cases as either as consolidated or individual class actions. Further, by executing the settlement, defendant does not admit that certification of a class is proper or appropriate pursuant to Fed. R. Civ. Pro. 23 or any other law or rule in this or any other lawsuit. Nor does defendant admit that it has engaged in any wrongful or culpable conduct or that any person has sustained any damage or loss by reason of any of the allegations made in these lawsuits. Rather, defendant has agreed to enter the settlement solely in order to put to rest all controversy and avoid further expense and protracted costly litigation.

2. Nothing contained in this MOU may be used or construed as an admission of any kind. Neither this MOU nor any of the documents filed in support of this MOU shall be offered or received as evidence in any proceeding or any court or other tribunal, civil or administrative, as an admission or concession or inference of wrongdoing of any kind on the part of defendant.

3. The settlement described herein is expressly conditioned upon satisfaction of the following:

- a. It is believed and understood by the parties, after widespread notice to the affected communities, including court-approved notice approved on July 10, 1995, that class members' property as defined in paragraph 5 have been fully identified. Notwithstanding, defendant has agreed to provide further notice as may be required by the Court.

The residential properties that the current class members own or where the current class members defined by paragraph 5 reside are identified in attached Exhibit 1. This settlement is expressly conditioned upon certification of a mandatory, non-opt out plaintiffs' class as that class is defined in paragraph 5 below and as that class has been identified to date. If the number of class members' properties increases by 10% or more above the number of properties identified in Exhibit 1 before the settlement is given final approval, then defendant, at its sole discretion, may terminate this MOU;

- b. The Court's determination that the settlement is fair and reasonable pursuant to Federal Rule of Civil Procedure 23(e) and the settlement being entered as a final judgment; and
- c. The final exhaustion of any appeal or challenge asserted in any court or tribunal, objecting to any aspect of settlement, including, but not limited to, the certification of a mandatory plaintiffs' class.

4. Upon final approval of the settlement as set forth in this MOU by the Court, the parties to this MOU (i.e., all class members as defined by paragraph 5 and Cyprus Foote) that have not raised a proper objection pursuant to paragraph 7 herein waive their respective rights of appeal of certification of the mandatory

class and entry of the settlement as a final judgment in Civil Action C2-94-1069, consolidated in whole with Civil Action C2-95-248, but retain their rights to:

- a. Enforce the settlement in the United States District Court for the Southern District of Ohio; and
- b. Defend the mandatory class certification and settlement in any appeal taken; and
- c. Fully litigate any and all claims or defenses that have been raised or which could have been raised in these Civil Actions if any appeal of the settlement by any other party or entity is granted and the final judgment incorporating this MOU is overturned or revised in any manner.

5. The settlement shall finally and conclusively resolve all claims pursuant to the release set forth in paragraph 6 herein by any member of the class in consolidated Case Numbers C2-94-1069 and C2-95-248. The mandatory, non-opt out class shall be composed of:

- a. All persons who own residential property or reside on residential property containing slag (whether or not subsequently removed), generated from production operations of Foote Mineral Company and its predecessors prior to May 13, 1987, at the plant currently owned by ShieldAlloy Metallurgical Corporation located in Byesville, Ohio.

b. This MOU expressly excludes all persons who received slag generated from production operations owned and/or operated by ShieldAlloy Metallurgical Company and its affiliates, subsidiaries, predecessors and successors as well as any other company that is unaffiliated with Cyprus Foote Mineral Company. It is expressly acknowledged that Foote Mineral Company ceased ownership and operation of the plant in question on May 13, 1987.

6. When the Court's ruling approving the Settlement becomes final and all appeals are fully exhausted, plaintiffs' class shall, by order of the Court on behalf of the class, release with prejudice, acquit and forever discharge defendant Cyprus Foote Mineral Company, its subsidiaries, affiliates, successors and assigns, and all past, present and future directors, shareholders, officers, agents and employees and all related and associated companies and their respective past, present and future directors, shareholders, officers, agents, employees, predecessors, successors and assigns from any and all actions, causes of action, claims, demands, losses and damages, compensatory, punitive and exemplary, of whatsoever kind or nature which plaintiffs' class had or now has or may hereafter have arising directly or indirectly from, out of or in any way related to the slag described in paragraph 5(a) of this MOU and including, but not limited to (a) claims for (i) fear of cancer, disease or of contracting any illness, injury, or impairment; (ii) increased risk of cancer, disease or of contracting any illness, injury, or impairment; (iii) mental injury

or impairment, (iv) medical monitoring, (v) loss of consortium, and (vi) emotional distress, discomfort, injury or impairment, including the physical symptomology proximately caused thereby; (b) claims for compensatory, exemplary or punitive damages; (c) negligence, willful and reckless conduct, private nuisance, public nuisance, property diminution, property damage, stigma, ultrahazardous activity, trespass, fraudulent concealment, breach of the implied warranty of merchantability, and breach of the implied warranty of fitness for particular purpose claims; (d) claims under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601, et seq.; and (e) any claim for attorneys' fees, costs and expenses in connection with this lawsuit and the slag described in paragraph 5 of this MOU; provided, however, this release does not extinguish any currently unknown future individual claims for compensatory damages for latent physical injuries proximately caused by the slag described in paragraph 5 of this MOU that have not manifested themselves up to the effective date of the Settlement.

7. The parties agree to move for and take all appropriate steps to finalize the settlement and agree:

- a. To request jointly that the Court preliminarily approve the settlement;
- b. To request jointly that the Court order that notice be directed to class members advising them of the settlement and advising them of their right to object, the effect of a non-objection, and the date of this Court's fairness hearing pursuant to

Federal Rule of Civil Procedure 23(e). It is agreed that residential properties where members of the class as defined in paragraph 5 reside and that class members own have been identified and that best practicable notice, subject to Court approval, is first class United States mail:

- (i) The notice to be mailed shall be jointly prepared and submitted to the Court for approval within 30 days of the Court's preliminary approval of the settlement.
- (ii) Lead class counsel Richard Alexander of Alexander, Rapazzini & Graham, San Jose, California, shall send out all Court-approved notices and certify to the Court that all identified class members were mailed notice in accordance with this MOU and Court approval.
- (iii) Defendant agrees to pay all postage costs of the notice as described herein.
- (iv) Those class members wishing to file objections to the settlement must file those objections with the Court along with an explanation of each and every reason they object to the settlement, including any support for their objections 15 business days prior to the date of the Court-scheduled 23(e)

fairness hearing. Any objections not made in accordance with this provision are deemed waived and shall not be a part of the record before the Court. Notices of objections shall be filed with the Court and shall be served by regular first-class U.S. mail to:

Richard Alexander
Lead Class Counsel
Alexander, Rapazzini & Graham
55 South Market Street
Suite 1080
San Jose, California 95113

Robert B. Casarona, Esq.
Counsel for Cyprus Foote Mineral
Company
Climaco, Climaco, Seminatore,
Lefkowitz & Garofoli Co., L.P.A.
The Halle Building, Suite 900
1228 Euclid Avenue
Cleveland, Ohio 44115

c. To jointly seek a final judgment consistent with paragraph 6 herein within 3 days following the final approval of the settlement by the Court.

8. Within 30 days of Preliminary Approval of the settlement, defendant shall deliver to the U.S. District Court for the Southern District of Ohio or to an interest-bearing account designated by the Court the sum of \$850,000.00, said sum representing money damages incidental to the injunctive relief provided herein payable to the plaintiffs' class. As soon as practicable, the fund shall be invested in government-insured

interest-bearing instruments approved by the Court.¹ Any interest earned on the fund shall become part of the fund. Except as set forth herein, no money shall be withdrawn from the fund until the Court and only after the Court has (i) certified a mandatory, non-opt out plaintiffs' class, (ii) approved the settlement according to its terms, and (iii) all appeals are exhausted.

9. Upon the Court's approval of the settlement, defendant and its attorneys and representatives shall be relieved of all further responsibility or obligation with respect to administration of the incidental monetary damages to be paid pursuant to the settlement. As soon as practicable, the Court shall select a "master" or a "trustee" who shall determine the protocol for distribution of the fund to the class members and to accomplish actual distribution of the fund to the class members. No funds shall be distributed until the Court has certified the mandatory, non-opt out class, entered a final order approving the settlement as fair and reasonable, and all appeals and challenges are finally exhausted. Lead class counsel, Richard Alexander of Alexander, Rapazzini & Graham, shall act in an advisory capacity to the "master" or "trustee" and shall assist in the development of a protocol for the processing of claims and distribution of funds, and in any other matter requested by the Court. Defendant agrees to pay lead class counsel reasonable attorney fees and costs associated with lead class counsel's involvement with

¹Such instruments shall not have restrictions upon withdrawal which would frustrate or impede return of the fund to defendant pursuant to paragraph 10 below.

administration of the settlement fund. All final decisions with respect to protocol shall be made by the "master" or "trustee." Any objection to a decision made by the "master" or "trustee" shall be made within 7 days of the "master's" decision to the Court, for final decision. It is expressly agreed that the Court's decision on any such objection is binding and final in this respect and shall not be subject to appeal.

10. In the event that this Court does not certify the mandatory, non-opt out plaintiffs' class as that class is defined in paragraph 5 herein, or does not determine that the settlement as proposed is fair and reasonable and enter the settlement as a final judgment, or in the event that the settlement is not consummated or finalized for any reason, including, but not limited to, the non-affirmation of the settlement as constituted and set forth in this MOU by any court of appeal, then the fund and all accumulated interest shall be returned to defendant within 30 days after entry of judgment of any appeal of the settlement and/or the last day upon which an appeal to any aspect of the settlement could be filed. In addition, upon the final distribution of all monies owed pursuant to this MOU, any monies remaining in the fund shall be returned to Cyprus Foote.

11. The costs of administration of the fund shall be paid separately from the fund by defendant by express written order of the Court.

12. The Malernees, McMasters, Strawsburgs and those class members identified by virtue of evaluation done pursuant to paragraph 17 that meet the criteria of paragraph 17(a) of this MOU

shall be considered Subclass 1. Each identified individual family with class members in Subclass 1 ("Subclass 1 families") that reside at the properties identified in Exhibit 2, as amended for properties that may be added after evaluation pursuant to paragraph 17, shall be entitled to receive one lump sum total payment of \$40,000 from the fund established pursuant to paragraph 8. The payment shall be distributed pursuant to and in accordance with paragraph 9 herein. In addition, defendant agrees that it shall purchase and/or remediate the identified properties in Subclass 1. The properties to be remediated and/or purchased are set forth in Exhibit 2, as amended for properties that may be added after evaluation pursuant to paragraph 17. The decision on whether to purchase the property shall be made by defendant, at its sole discretion, after consultation with each respective property owner of record.

- a. Remediation, if chosen, shall be the excavation and removal of the slag described in paragraph 5 from the property.
- b. If defendant decides to purchase the property, the price shall be determined by appraisal paid for by defendant. The appraiser will be jointly selected by defendant and property owner from a list of Ohio licensed real estate appraisers.
- c. Defendant's decision on whether it will purchase the property shall be made within 60 days of final Court approval of the settlement and the exhaustion of all appeals.

d. If remediation is performed and defendant chooses not to purchase the property, defendant shall pay reasonable and necessary temporary living expenses to the affected class member(s) while excavation of the slag occurs. The justification for and cost of temporary living arrangements under this scenario must be approved by defendant prior to payment. Any objection to the defendant's approval or lack thereof shall be appealed to the master or trustee within 7 days of notice of the defendant's decision. The master's or trustee's decision shall be final and binding upon all the parties. Within 30 days of the final decision made with respect to any temporary living arrangements, defendant agrees to fund the cost of those arrangements that were paid or are to be paid out of the fund. In addition, if remediation is selected by defendant, the steps identified for radon testing and any radon mitigation under Subclass 3, except for those in paragraph 14(e), shall apply as written herein.

13. The Downing family and those class members identified by virtue of evaluations done pursuant to paragraph 17 that meet the criteria of paragraph 17(b) of this MOU shall be considered Subclass 2. Each identified individual family with class members in Subclass 2 ("Subclass 2 families") that resides at the properties identified in Exhibit 3, as amended for properties added after evaluation is performed pursuant to paragraph 17, shall

be entitled to receive one lump sum total payment of \$20,000 from the fund established in paragraph 8. The payment shall be distributed pursuant to and in accordance with paragraph 9 herein. In addition, defendant agrees that it shall either remediate or purchase the identified property in Subclass 2. The properties to be remediated and/or purchased are set forth in Exhibit 2, as amended for properties that may be added after evaluation pursuant to paragraph 17. The decision to remediate or purchase the property shall be at defendant's sole discretion after consultation with each property owner of record.

- a. Remediation, if chosen, shall be the excavation and removal of slag described in paragraph 5 from the property.
- b. If defendant decides to purchase the property, the price shall be determined by appraisal paid for by defendant. The appraiser shall be jointly selected by defendant and the property owner from a list of Ohio licensed real estate appraisers.
- c. Defendant's decision on whether to purchase the property shall be made within 60 days of final Court approval of the settlement and the final exhaustion of all appeals.
- d. If remediation is performed and defendant chooses not to purchase the property, defendant shall pay reasonable and necessary temporary living expenses to the affected class member(s) while excavation of the slag occurs. The justification for and cost

of temporary living arrangements under this scenario must be approved by defendant prior to payment. Any objection to the defendant's approval or lack thereof shall be appealed to the master or trustee within 7 days of notice of the defendant's decision. The master's or trustee's decision shall be final and binding upon all the parties. Within 30 days of the final decision made with respect to any temporary living arrangements, defendant agrees to fund the cost of those arrangements that were paid or are to be paid out of the fund. In addition, if remediation is selected by defendant, the steps identified for radon testing and any radon mitigation under Subclass 3, except for those in paragraph 14(e), shall apply as written herein.

14. Subclass 3 shall include class members that own or reside on properties with slag located against or contiguous to their respective residential dwellings' living quarters' foundation. Such slag must be in place and used as an underground construction material as opposed to use for driveways or walkways or for other surface use. Subclass 3 shall not include those class members in Subclasses 1, 2 or 4. For each identified property where class members reside or that class members own identified in Exhibit 4, as amended for properties that may be added after testing pursuant to paragraph 17 herein, defendant agrees to the following relief:

- a. Defendant shall conduct short-term radon testing in the home if requested by the property owner or lead class counsel on behalf of the property owner in writing by October 15, 1996. Protest, Inc., a licensed State of Ohio radon testing company, shall perform the testing in accordance with the procedure set forth in Exhibit 5. The testing shall take place in November or December, 1996 unless the settlement is not approved or is held up by an appeal.
- b. Any property owner class member with radon test results exceeding 4 pCi/l shall be entitled to a radon mitigation system at defendant's expense.
- c. The radon mitigation company shall be selected by defendant. The property owner of record shall have the right to a reasonable objection on the selection, provided such objection is made in writing within 14 days after written notification by defendant of the identity of the radon mitigation company selected. The failure of the property owner to make a timely objection shall waive any right to object to the selection of the radon mitigation company.
- d. Within 7 days of the installation of a radon mitigation system, defendant shall direct Protest, Inc. to perform a test to determine if the system is working. If the test results indicate radon

exceeding 4 Pci/l in the home, defendant shall change the system as necessary to accomplish a reading below 4 Pci/l in the home.

e. The owner(s) of record of each property in Subclass 3 shall be entitled to receive from the fund established pursuant to paragraph 8 herein:

- (i) A lump sum of \$15,000; or
- (ii) 10% of the appraised value of their property.

The decision in this regard is at the property owner's sole discretion and the property owner must notify defendant and the "trustee" or "master" appointed pursuant to paragraph 8 herein of its selection in writing within 60 days of the installation of the radon mitigation system. If the owner of record chooses to accept 10% of the appraised property value, the appraisal shall be paid for by the owner of record. The appraiser shall be jointly selected by class counsel and defendant. If the appraisal value exceeds \$15,000, defendant agrees to submit to the Court for deposit into the fund provided for by paragraph 8 the amount of the excess within 30 days of notification by the "master" or "trustee." For example, if the appraisal results in the property owner being entitled to \$25,000, then defendant, upon proper notification as provided for herein, shall deliver

\$10,000 to the "Master" or "Trustee" to be deposited into the fund.

- f. Once the work to be completed under this section is done, defendant's obligations hereunder are discharged. Each property owner agrees that any objection with respect to the work being done in accordance with this settlement must be made to the Master or Trustee. Defendant shall be given 7 business days to respond to the objection. Any decision made by the Master or Trustee shall be binding and final, not subject to any appeal.

15. Subclass 4 shall include all class members who own property containing slag except for those class members in Subclass 1, Subclass 2 and Subclass 3. Each class member who is the property owner of record of the properties identified in Exhibit 6, as amended for properties added after evaluation is performed pursuant to paragraph 17, shall be entitled to \$5,000 from the fund established pursuant to paragraph 8 herein.

16. If any property owner refuses to execute and abide by the terms of the attached access agreement (Exhibit 7) or rejects or refuses access, such refusal and objection shall be deemed compliance and defendant is released from any further obligation under the settlement with respect to that property and the class members that own or reside at the property.

17. Defendant agrees to evaluate the remaining class members' properties that have not been evaluated to date. Those properties are identified by Exhibit 8, attached and incorporated

herein. The testing analysis and evaluation shall be in substantial conformity with the previous testing analysis and evaluation done to date by defendant and as set forth in Exhibit 9. Lead Class Counsel's experts shall be allowed the opportunity to participate in the testing and evaluation with the understanding that it shall be in substantial conformity with the previous process and evaluation done to date. The Beskid property at 58795 Grisback Road, Byesville, Ohio 43723 shall be included in this subclass. The results of the evaluation, testing and analysis and of the resulting data obtained from the untested properties, including the Beskid property, shall determine which subclass a class member with untested property shall be included in, if any, at the conclusion of the evaluation. All testing analysis, dose modeling and dose evaluation shall be in substantial conformity with the work done by defendant's experts, Woodward-Clyde and Auxier & Associates, to date, as described in Exhibit 9.

- a. Each property containing slag where the sum of fractions as calculated from measurements of various radionuclides present corresponds to a hypothetical future dose, estimated by the RESRAD and described in Exhibit 9, greater than or equal to 100 mrem/yr shall be included with and shall entitle the class members to the same relief as Subclass 1.
- b. Each property containing slag where the sum of fractions as calculated from measurements of various radionuclides present corresponds to a

hypothetical future dose, estimated by the RESRAD and described in Exhibit 9, greater than or equal to 50 mrem/yr but less than 100 mrem/yr shall be included with and shall entitle the class members to the same relief as Subclass 2.

- c. Each property that contains slag against or contiguous to the residential dwellings' living quarters' foundation that is not included in subclass 1, 2 or 4 shall be included with and shall entitle the class members to the same relief as that provided in Subclass 3.
- d. Each property containing slag where the sum of fractions as calculated from measurements of various radionuclides present corresponds to a hypothetical future dose, estimated by the RESRAD and described in Exhibit 9, less than 50 mrem/yr shall be included with and shall entitle the class members to the same relief as Subclass 4.
- e. Any class member whose property is identified on Exhibit 8 that seeks to have its property evaluated pursuant to paragraph 17 shall first respond to a written questionnaire prepared by defendant and approved by lead class counsel to determine whether the property owner will fall within one of the subclasses and is thus entitled to have the property further evaluated pursuant to this paragraph 17. If the class member objects to the

defendant's decision under this subparagraph, he/she shall provide "sufficient evidence" of entitlement to further evaluation pursuant to this paragraph 17. For the purposes of this paragraph, "sufficient evidence" shall be a sworn affidavit under penalty of perjury verifying the basis for further evaluation. It shall be deemed to be sufficient evidence if the sworn affidavit sets forth facts sufficient to establish that the residential property that the class member owns or resides upon contains slag originating from Foote Mineral Company or its predecessor prior to May 13, 1987. If the defendant deems the evidence insufficient and continues to refuse to further evaluate the property and the class member that owns or resides on the subject property objects to defendant's refusal to further evaluate the property, he shall submit a written claim to the "master" or "trustee" appointed pursuant to paragraph 8 herein within 7 business days from receipt of defendant's written rejection. Defendant shall have 7 business days from the receipt of written notice of such a claim to submit a reply to the claim to the master or trustee. The Master or Trustee shall then make a decision within 5 business days. If either party objects to the "master's" decision, then defendant or property

owner can make an appeal to this Court within 7 days of the "master's" written decision. The Court's decision shall be final and binding in this respect and shall not be subject to appeal.

18. It is agreed that Subclasses 1, 2, 3 and 4 are mutually exclusive and that the relief provided in each is not cumulative.

19. Defendant agrees to deposit within 30 days of completing the evaluation set forth in paragraph 17 with respect to the categorization of class members into subclasses, sufficient money in the fund to cover the additional class members' incidental money damages.

20. Defendant agrees to pay a one lump sum total payment of \$65,000 to the Court-appointed class representatives of the consolidated lawsuit. This one lump sum total payment shall be paid out of the fund established pursuant to paragraph 8.

21. Defendant agrees to pay the reasonable attorney fees of lead class counsel that have been approved as fair and reasonable by the Court. Said fees shall be presented for review to defendant subsequent to this MOU being presented to the Court and subsequent to this Court's final approval. The plaintiffs' attorney fees have not and shall not be discussed prior to that time. Defendant will pay for reasonable and proper costs and expenses, including the Lead Class Counsel's expert fees. In this regard, defendant will pay up to \$200,000 for reasonable and proper expert fees, costs and expenses incurred by lead class counsel. Lead class counsel agrees to notify their experts immediately to

cease all work and to limit their future work to specific tasks required by this MOU.

22. Defendant shall have the right at its discretion and in accordance with applicable law to record notice of the existence of this lawsuit and settlement at any class members' property. Such notice must be approved by lead class counsel prior to recording. In addition, class member property owners agree to disclose the existence of this settlement to any subsequent purchaser of their property and shall include the language jointly agreed as attached in Exhibit 10 to the Residential Property Disclosure Form required to be exchanged pursuant to Ohio Revised Code Section 5302.30.

23. Class members agree that they will forever be barred from instituting, pursuing or in any way aiding any claim, cause of action, or demand discharged and released by the settlement described herein, that the settlement may be pleaded as a full and complete defense to any such discharged and released claim, cause of action or demand and that the settlement or the facts upon which it is based are not admissible in any other civil, judicial or administrative proceeding, except a proceeding to enforce the terms of the settlement.

24. This Court shall retain jurisdiction over all matters, including this MOU and the parties thereto and enforcement thereof, the fund and, the administration of the settlement.

25. It is agreed that this MOU and its terms shall remain confidential between the class members or potential class members identified as of the signing of this MOU and defendant and

shall not be released to the public or filed as a public document until the Court preliminarily approves the settlement.

This document represents the complete understanding of the parties regarding settlement and supersedes any prior written or oral communication.

APPROVED AND AGREED TO:

FOR PLAINTIFFS' CLASS:

Richard P. Alexander
for Richard Alexander, Esq.
Lead Class Counsel
Alexander, Rapazzini & Graham
55 South Market Street
Suite 1080
San Jose, California 95113

Date: 613, 1996

FOR DEFENDANT CYPRUS FOOTE
MINERAL COMPANY

Robert B. Casarona
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Climaco, Climaco, Seminatore,
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L.P.A.
Suite 900, The Halle Building
1228 Euclid Avenue
Cleveland, Ohio 44115
Trial Attorney for Cyprus Foote
Mineral Company

Date: June 14, 1996

EXHIBIT 1

EXHIBIT 1

RESIDENTIAL PROPERTIES FALLING WITHIN CLASS

<u>Name</u>	<u>Address</u>	<u>City</u>	<u>Zip Code</u>	<u>Property Designation</u>	<u>Tested</u>
Anderson, Loren	306 South 25th St.	Cambridge	43725	O-48	Yes
Barrett, Edward & Suzanne	102 Eastview Dr.	New Concord	43762	P2-38	Yes
Bauman, Sherwood	354 Cowgill Lane	Cumberland	43732	N/A	No
Beskid, Jill & Steve	58795 Grisak Road	Byesville	43723	O-18	Yes
Bollinger, Mrs. Ray	13266 Bohemian Rd.	Lone City	43755	P2-39	Yes
Bugher, John	6570 Brick Church Rd.	Cambridge	43725	O-04	Yes
Callahan, Allan	57463 Northstar Road	Pleasant City	43772	N/A	No
Carlson, Cecil	18378 Anderson Road	Kimbolton	43749	N/A	No
Carpenter, Jack	5026 Skyline Dr.	Cambridge	43725	O-42	Yes
Chapman, Terry	14720 Zane Rd.	Lone City	43755	P2-01	Yes
Chismar, Geneva	56717 Cherry Hill Rd.	Buffalo	43780	O-09	Yes
Clark, Harold	McClary Road	Lower Salem	45745	N/A	No
Cochran, John & Janet	20026 Gregg St.	Senecaville	43780	O-17	Yes
Cook, Josie	61092 Southgate Rd.	Cambridge	43725	P2-57	Yes
Cooley, Greg	58723 Hendershot Road	Cumberland	43732	O-21	Yes
Cooper, Barry	206 Brown Ave.	Senecaville	43780	P2-02	Yes
Coulter, Charles	5593 Skyline Dr.	Cambridge	43725	O-44	Yes
Cox, Rick	17280 Anderson Road	Kimbolton	43749	O-01	Yes
Cunningham, Rich	57624 North Star Road	Pleasant City	43772	O-33	Yes
Cyramut, Don	310 S. 25th Street	Cambridge	43725	N/A	No
Delik, William & Marie	62243 Highhill Rd.	Cambridge	43725	O-23	Yes
Dilley, Fred	10271 Twin Oak Dr.	Cambridge	43725	O-50	Yes
Dinges, Jay	61020 Brookside Ln. #19	Lone City	43755	O-06	Yes
Dodd, Ronald	3191 Harding Ln.	New Concord	43762	O-20	Yes
Downing, Charlene	7311 Brick Church Road	Cambridge	43725	O-05	Yes
Duffy, Robert E.	4231 Peters Creek Road	Cambridge	43725	N/A	No
Durant, Beth	109 Eastview Drive	New Concord	43762	N/A	No
Emerson, Robert	703 Lakeview Drive	Cambridge	43725	P2-03	Yes
Fields, Robert	436 North 5th St.	Cambridge	43725	P2-04	Yes
Flemming, Ron	4842 Bloomfield Rd.	Cambridge	43725	P2-05	Yes
Fraleigh, Roy	8990 Brick Church Road	Cambridge	43725	P2-06	Yes
Gerda, Mrs. Charles	11034 North St. Box 23	Darwent	43733	O-34	Yes
Gesaman, Lowell	59231 Palmer St.	Byesville	43723	O-37	Yes
Girten, Joseph & Glenda	65328 Pigeon Gap Rd.	Cambridge	43725	O-38	Yes
Gotschall, Mark	5050 Skyline Dr.	Cambridge	43725	O-43	Yes
Gannon, Ellen	10738 Linwood Dr.	Pleasant City	43772	O-25	Yes
Gannon, Fred	9170 Lucasburg Rd.	Byesville	43723	O-29	Yes
Harris, Gene & Helen	10882 Seneca Lane	Byesville	43723	O-41	Yes
Haught, Judy	13404 Catbird Rd.	Byesville	43723	O-08	Yes
Hill, Mark	64597 Slaughter Hill Rd.	Cambridge	43725	P2-56	Yes
Hollenbeck, Diane	59785 Wintergreen Rd.	Senecaville	43780	O-52	Yes
Howell, Pat	59133 Little Kate Road	Byesville	43723	P2-51	Yes
Huddock, John	421 North 6th St.	Cambridge	43725	P2-55	Yes
Jackson, Gene	61701 Institute Rd.	Lone City	43755	P2-07	Yes
Johnson, Jimmy	5753 Klass Rd.	Cambridge	43725	P2-08	Yes
Johnson, Tommy	60289 Claysville Rd.	Cambridge	43725	P2-09	Yes
Jennedy, Donald	520 Harrison Road	Cambridge	43725	N/A	No

Cirkman, LorieAnn	59250 Little Kate Rd.	Byesville	43723	O-27	Yes
Land, Ed	66579 Lake Ridge Dr.	Old Washington	43768	P2-58	Yes
LaRue, Carl	63825 Arrowhead Road	Cambridge	43725	N/A	No
LaRue, William	60934 High Hill Road	Cambridge	43725	N/A	No
Leidner, Robert	136 East St.	Lone City	43755	O-13	Yes
Little, Pamela	10721 Linwood Rd.	Pleasant City	43772	P2-10	Yes
Lucas, Darlene	60145 Wintergreen Road	Pleasant City	43772	N/A	No
Lukehart, Karen and Don	59087 Marietta Road	Byesville	43723	N/A	No
Mahaffy, Tom	61783 Shaw Road	Cambridge	43725	N/A	No
Malernee, Sue Ann	58815 Grisak Road	Byesville	43723	O-19	Yes
Mathias, Charles	25920 Township Rd., 1052	Quaker City	43773	P2-43	Yes
McCance, Shirley	61148 Oakwood Rd.	Byesville	43723	O-36	Yes
McCune, Cheryl	59382 Claysville Rd.	Cambridge	43725	P2-12	Yes
McFadden, Anna	10131 Elm St.	Byesville	43723	P2-11	Yes
McMasters, Mary Francis	10215 Sycamore Road	Byesville	43723	O-47	Yes
Mesarchik, Larry	10167 Catapla Street	Byesville	43723	O-07	Yes
Aetheney, Carol	9131 Lucasburg Rd.	Byesville	43723	P2-13	Yes
Moore, Dan	61149 Southgate Rd.	Cambridge	43725	O-46	Yes
Moore, Sue	11152 Seneca Ln.	Byesville	43723	P2-14	Yes
Moorehead, Betty	20006 Gregg St.	Senecaville	43780	O-16	Yes
Mulligan, John	14785 Walhanding Road	Senecaville	43780	O-51	Yes
Nasser, Jack	9123 Eagleberry Rd.	Cambridge	43725	O-14	Yes
Porter, Bob	6740 Matthew Lane	Cambridge	43725	N/A	No
Ramshaw, John & Bonnie	68014 Loftland Rd.	Cambridge	43725	O-28	Yes
Reed, Jim	1983 Greenwood Ave.	Cambridge	43725	P2-44	Yes
Reed, Verda	63302 Bobs Run Rd.	Cambridge	43725	P2-45	Yes
Reinhardt, Leonard	62707 Beverly Ln.	Cambridge	43725	P2-46	Yes
Robbie, Robert	60352 Claysville Rd.	Cambridge	43725	O-11	Yes
Roberts, Phyllis	11275 Ideal Rd.	Byesville	43723	O-24	Yes
Rubright, James	336 Bass Ln.	Senecaville	43780	P2-47	Yes
Saintenoy, Karen	223 North High St.	Senecaville	43780	P2-48	Yes
Schott, Dennis	12335 Tavener Blvd.	New Concord	43762	O-49	Yes
Scott, Lee	59309 Country Club Rd.	Byesville	43723	P2-16	Yes
Sicrapchanski, Steve & Barb	53210 Country Rd. 36	Pleasant City	43772	P2-49	Yes
Sicard, Wayne & Diana	64508 Slade Rd.	Cambridge	43725	P2-50	Yes
Snyder, Albert	10758 Linwood Dr.	Pleasant City	43772	O-26	Yes
Stewart, Linda	Red Ln.	Cumberland	43732	O-40	Yes
Strawburg, Allan	66865 Barrett Hill Road	Cambridge	43725	Straw	Yes
Tickhill, Susan	59152 Clagett Rd.	New Concord	43762	P2-18	Yes
Unknown Owner	225 Church Street	Senecaville	43780	O-54	No
Unknown Owner	1165 Steubenville Avenue	Cambridge	43725	N/A	No
Unknown Owner	917 Garfield Avenue	Cambridge	43725	N/A	No
Unknown Owner	Barret Hill Road	Cambridge	43725	N/A	No
Unknown Owner	57444 Boston Way Drive	Claysville	43725	O-03	No
Jrdak, Paul & Susan	115 Locust Street	Salesville	43778	N/A	No
Viars, Earl	14220 Freedom Rd.	Kimbolton	43749	O-15	Yes
Wondran, Jeannie	61110 Oakwood Rd.	Byesville	43723	O-35	Yes
Ward, Raymond	61159 Maple Dr.	Byesville	43723	P2-52	Yes
Warehime, Herbert	8577 Claypike Rd.	Cambridge	43725	P2-20	Yes
Vells, Joanne	5280 College Hill Rd.	Cambridge	43725	P2-53	Yes
Verner, Bob & Kathy	65373 Matthew Rd.	Cambridge	43725	O-32	Yes
Whiteley, Paul	116 Glass Avenue	Byesville	43723	N/A	No
Wiggins, Daniel	6350 Chestnut Hill Rd.	Cambridge	43725	P2-21	Yes
Winnett, Marsha	10673 Twin Oaks Dr.	Cambridge	43725	P2-23	Yes

Zvolensky, Michael

8111 Gable Road

Cambridge

43725

P2-59

Yes

EXHIBIT 2

EXHIBIT 2

SUBCLASS 1 PROPERTIES

<u>Name</u>	<u>Address</u>	<u>City</u>	<u>Zip Code</u>	<u>Property Designation</u>
Alarnee, Sue Ann	58815 Grisak Road	Byesville	43723	O-19
McMasters, Mary Francis	10215 Sycamore Road	Byesville	43723	O-47
Strawsburg, Allan	66865 Barrett Hill Road	Cambridge	43725	Straw

EXHIBIT 3

EXHIBIT 3

SUBCLASS 2 PROPERTIES

<u>Name</u>	<u>Address</u>	<u>City</u>	<u>Zip Code</u>	<u>Property Designation</u>
Downing, Charlene	7311 Brick Church Road	Cambridge	43725	O-05

EXHIBIT 4

EXHIBIT 4

SUBCLASS 3 PROPERTIES

<u>Name</u>	<u>Address</u>	<u>City</u>	<u>Zip Code</u>	<u>Property Designation</u>	
Beskid, Jill & Steve	58795 Grisak Road	Byesville	43723	O-18	Yes
Cooley, Greg	58723 Hendershot Road	Cumberland	43732	O-21	
Cox, Rick	17280 Anderson Road	Kimbolton	43749	O-01	
Emerson, Robert	703 Lakeview Drive	Cambridge	43725	P2-03	
Frable, Roy	8990 Brick Church Road	Cambridge	43725	P2-06	
Harris, Gene & Helen	10882 Seneca Lane	Byesville	43723	O-41	
Howell, Pat	59133 Little Kate Road	Byesville	43723	P2-51	
Mesarchik, Larry	10167 Catapla Street	Byesville	43723	O-07	
Mulligan, John	14785 Walhanding Road	Senecaville	43780	O-51	
Schott, Dennis	12335 Tavener Blvd.	New Concord	43762	O-49	

EXHIBIT 5

EXHIBIT 5

TESTING PROCEDURE

This exhibit describes the testing procedure for short-term radon testing. The necessary materials and the responsibilities of the testing company and property owner are described first. This is followed by a step-by-step description of the procedure.

Necessary Materials

- Charcoal canister test kits that meet the requirements of U.S. EPA's Radon Measurement Proficiency (RMP) program
- Written instructions for distribution to property owner
- Form to record date and time of canister placement and retrieval, and other relevant information
- Pen and watch

Responsibilities of the Testing Company

- Performing a radon test consistent with U.S. EPA protocols
- Arranging the date and time of canister placement and retrieval with the property owner
- Providing a set of written instructions to the property owner and explaining the possibility of inaccurate test results if instructions are not followed
- Proper placement and retrieval of charcoal canisters
- Written documentation of testing location and canister identification numbers
- Written documentation of the date and time of the beginning and end of the test
- Analysis of test canister(s) by a laboratory certified by the Ohio Department of Health
- Reporting of radon test results

Responsibilities of the Property Owner

- Allowing the testing company access to the home for placement and retrieval of the charcoal canisters
- Reading the written test instructions provided by testing company
- Maintaining closed house conditions during test and for 12 hours prior to the start of the test (Closed house conditions consist of keeping doors and windows closed except for normal entry and exit, and minimal use of ventilation systems (e.g. house fans) that mix indoor and outdoor air.)
- Property owner must not move, touch or tamper with the testing canisters.

Testing will be performed by a company licensed by the State of Ohio to perform radon testing. Tests will be of a short term nature (between 48 hours and 7 days) using U. S. EPA certified charcoal canister test kits. Testing will be performed in November or December, 1996. Testing should not be performed during periods of rapidly changing or stormy weather since such conditions may cause significant variability in radon levels.

TESTING PROCEDURE

Testing Steps

Upon notification of the need for testing, the testing company shall perform the following steps.

1. Notify the property owner of the intent to conduct a radon test in the home. Inform the property owner that the testing will require his/her cooperation and some preliminary preparation on his/her part. Provide a written set of instructions to the property owner. Review the list of property owner responsibilities with the property owner. These include the need not to tamper with the test canister during the test, and the need to maintain closed house conditions during the test and for 12 hours prior to the test.
2. Arrange a time with the property owner for the start and finish of the radon test. The layout of the home and the locations of the canisters should be reviewed with the property owner. The date and time of the beginning of the closed house conditions and the placement and retrieval of the canisters should be clearly defined by the testing company for the property owner.
3. The property owner should be contacted 12 to 24 hours prior to the beginning of the test and reminded of the need to maintain closed house conditions prior to and during the test.
4. Arrive at the property on time and notify the owner of arrival. Confirm that closed house conditions have been maintained for 12 hours prior to the beginning of the testing. (Reschedule the test if necessary to meet the requirements for closed house conditions prior to testing.) Place one charcoal canister on each livable level of the home. Preference for canister location shall be given to family rooms, living rooms and occupied bedrooms. Canisters should not be placed near exterior walls, ventilation ducts, sumps, kitchens, bathrooms or utility rooms. Place canisters a minimum of two feet above the floor, two feet below the ceiling and away from large obstructions. Remind the property owner of the test period and the need to maintain closed house conditions throughout the test period.

TESTING PROCEDURE

5. Canisters will be marked prior to placement with the date, time and location of placement. A written record of placement for each home shall be kept by the testing company. These records shall include at a minimum:

- identification number for each canister
- date, time, and location of canister placement
- the property owner's indication as to whether closed house conditions have been maintained

The scheduled time for retrieval of the charcoal canisters should be reviewed with the property owner prior to leaving the home.

6. Return to the home at the scheduled time to retrieve the canisters. Record the date and time of retrieval on the canisters and on the written record for the property. Also note any observed discrepancies or signs of tampering on the placement records.
7. If testing has proceeded in accordance with protocol, ship the canister(s) to a laboratory certified for radon analysis by the Ohio Department of Health.

EXHIBIT 6

EXHIBIT 6

SUBCLASS 4 PROPERTIES

<u>Name</u>	<u>Address</u>	<u>City</u>	<u>Zip Code</u>	<u>Property Designation</u>
Anderson, Loren	306 South 25th St.	Cambridge	43725	O-48
Barrett, Edward & Suzanne	102 Eastview Dr.	New Concord	43762	P2-38
Bollinger, Mrs. Ray	13266 Bohemian Rd.	Lone City	43755	P2-39
Bugher, John	6570 Brick Church Rd.	Cambridge	43725	O-04
Carpenter, Jack	5026 Skyline Dr.	Cambridge	43725	O-42
Chapman, Terry	14720 Zane Rd.	Lone City	43755	P2-01
Chismar, Geneva	56717 Cherry Hill Rd.	Buffalo	43780	O-09
Cochran, John & Janet	20026 Gregg St.	Senecaville	43780	O-17
Cook, Josie	61092 Southgate Rd.	Cambridge	43725	P2-57
Cooper, Barry	206 Brown Ave.	Senecaville	43780	P2-02
Coulter, Charles	5593 Skyline Dr.	Cambridge	43725	O-44
Delik, William & Marie	62243 Highhill Rd.	Cambridge	43725	O-23
Dilley, Fred	10271 Twin Oak Dr.	Cambridge	43725	O-50
Dinges, Jay	61020 Brookside Ln. #19	Lone City	43755	O-06
Dodd, Ronald	3191 Harding Ln.	New Concord	43762	O-20
Fields, Robert	436 North 5th St.	Cambridge	43725	P2-04
Flemming, Ron	4842 Bloomfield Rd.	Cambridge	43725	P2-05
Gerdau, Mrs. Charles	11034 North St. Box 23	Darwent	43733	O-34
Gesaman, Lowell	59231 Palmer St.	Byesville	43723	O-37
Girten, Joseph & Glenda	65328 Pigeon Gap Rd.	Cambridge	43725	O-38
Gotschall, Mark	5050 Skyline Dr.	Cambridge	43725	O-43
Hannon, Ellen	10738 Linwood Dr.	Pleasant City	43772	O-25
Hannon, Fred	9170 Lucasburg Rd.	Byesville	43723	O-29
Haught, Judy	13404 Catbird Rd.	Byesville	43723	O-08
Hill, Mark	64597 Slaughter Hill Rd.	Cambridge	43725	P2-56
Hollenbeck, Diane	59785 Wintergreen Rd.	Senecaville	43780	O-52
Huddock, John	421 North 6th St.	Cambridge	43725	P2-55
Jackson, Gene	61701 Institute Rd.	Lone City	43755	P2-07
Johnson, Jimmy	5753 Klass Rd.	Cambridge	43725	P2-08
Johnson, Tommy	60289 Claysville Rd.	Cambridge	43725	P2-09
Kirkman, LorieAnn	59250 Little Kate Rd.	Byesville	43723	O-27
Land, Ed	66579 Lake Ridge Dr.	Old Washington	43768	P2-58
Leidner, Robert	136 East St	Lone City	43755	O-13
Little, Pamela	10721 Linwood Rd.	Pleasant City	43772	P2-10
Mathias, Charles	25920 Township Rd., 1052	Quaker City	43773	P2-43
McCance, Shirley	61148 Oakwood Rd.	Byesville	43723	O-36
McCune, Cheryl	59382 Claysville Rd.	Cambridge	43725	P2-12
McFadden, Anna	10131 Elm St.	Byesville	43723	P2-11
Metheney, Carol	9131 Lucasburg Rd.	Byesville	43723	P2-13
Moore, Dan	61149 Southgate Rd.	Cambridge	43725	O-46
Moore, Sue	11152 Seneca Ln.	Byesville	43723	P2-14
Moorehead, Betty	20006 Gregg St.	Senecaville	43780	O-16
Nasser, Jack	9123 Ecliberry Rd.	Cambridge	43725	O-14
Namshaw, John & Bonnie	63014 Loftland Rd.	Cambridge	43725	O-28
Reed, Jim	1983 Greenwood Ave.	Cambridge	43725	P2-44
Reed, Verda	63302 Bobs Run Rd.	Cambridge	43725	P2-45

Reinhardt, Leonard	62707 Beverly Ln.	Cambridge	43725	P2-46
Robbie, Robert	60352 Claysville Rd.	Cambridge	43725	O-11
Roberts, Phyllis	11275 Ideal Rd.	Byesville	43723	O-24
Rubright, James	336 Bass Ln.	Senecaville	43780	P2-47
Saintenoy, Karen	223 North High St.	Senecaville	43780	P2-48
Scott, Lee	59309 Country Club Rd.	Byesville	43723	P2-16
Scrapchanski, Steve & Barb	53210 Country Rd. 36	Pleasant City	43772	P2-49
Sicard, Wayne & Diana	64508 Slade Rd.	Cambridge	43725	P2-50
Snyder, Albert	10758 Linwood Dr.	Pleasant City	43772	O-26
Stewart, Linda	Red Ln.	Cumberland	43732	O-40
Tickhill, Susan	59152 Clagett Rd.	New Concord	43762	P2-18
Viars, Earl	14220 Freedom Rd.	Kimbolton	43749	O-15
Vondran, Jeannie	61110 Oakwood Rd.	Byesville	43723	O-35
Ward, Raymond	61159 Maple Dr.	Byesville	43723	P2-52
Warehime, Herbert	8577 Claypike Rd.	Cambridge	43725	P2-20
Wells, Joanne	5280 College Hill Rd.	Cambridge	43725	P2-53
Werner, Bob & Kathy	65373 Matthew Rd.	Cambridge	43725	O-32
Wiggins, Daniel	6350 Chestnut Hill Rd.	Cambridge	43725	P2-21
Winnett, Marsha	10673 Twin Oaks Dr.	Cambridge	43725	P2-23
Zvolensky, Michael	8111 Gable Road	Cambridge	43725	P2-59

EXHIBIT 7

EXHIBIT 7

ACCESS AGREEMENT

This ACCESS AGREEMENT is made and entered into as of _____, 1995 by and between Cyprus Foote Mineral Company, a Pennsylvania corporation ("Cyprus Foote") and _____ ("Owner").

Owner is the owner of that certain parcel of property located at _____ in _____, Ohio (the "Property");

Cyprus Foote operated an alloy processing plant in Cambridge, Ohio until 1987 whereby slag was produced and used by various individuals for construction, including, but not limited to, use as fill;

Cyprus Foote has denied liability for any faulty slag that may have been used, however, pursuant to a Settlement Agreement submitted for preliminary approval on June 14, 1996, Cyprus Foote has agreed to take certain action that requires access;

Cyprus Foote desires to have access to the Property as needed to comply with the Settlement Agreement that incorporates this Access Agreement as Exhibit 7;

NOW, THEREFORE, in consideration of the mutual covenants and agreements described below, the parties agree as follows:

1. Access. Owner grants Cyprus Foote and its agents, consultants, contractors and subcontractors (collectively, its "Representatives") a license to enter the Property for the purpose of allowing Cyprus Foote or its Representatives to perform activities necessary to meet its obligations under the Settlement Agreement. Such access will include the right to take samples at the Property, to transport, install and maintain on the Property such sampling or monitoring equipment as may be necessary to perform the investigatory activities, to remove sample material from the Property as required, to cross over the Property or to undertake other such activities as may be reasonably necessary to comply with the Settlement.

2. Notice. To the maximum extent possible, prior to any entry onto the Property, Cyprus Foote or its Representatives shall give notice to Owner, at the address set out above, of its intent to enter the Property, including the expected date and time of such entry. Cyprus Foote and/or its Representatives may enter the Property only during the hours between 8:00 a.m. and 5:30 p.m., unless Owner grants specific consent to extend access outside these hours.

3. Repair and Restoration. Cyprus Foote agrees to use its best efforts to minimize any adverse impact on the

Property resulting from its activities. If any portion of the Property suffers damage resulting from the investigatory activities, Cyprus Foote or its Representative(s) shall promptly repair such damage at Cyprus Foote's or its Representative's own cost and expense. Cyprus Foote agrees that, upon the final completion of its activities requiring access, Cyprus Foote will make reasonable restoration of any alterations caused by Cyprus Foote.

4. Cyprus Foote's Indemnification. Cyprus Foote, on behalf of itself and its successors and assigns, agrees to protect, indemnify, defend and hold harmless Owner from and against any and all liabilities, suits, claims, demands, judgments and causes of action (collectively, "Claims") asserted by any person against Owner as a direct result of the access to and use of the Property by Cyprus Foote or its Representatives. Owner shall give Cyprus Foote written notice of any such Claims within thirty (30) days of receipt of notice by Owner. Cyprus Foote shall defend any such Claims using counsel selected by Cyprus Foote in its sole discretion.

5. No Liens. Cyprus Foote shall not suffer or permit to be enforced against the Property, or any part thereof, any mechanics', materialmen's, contractors' or subcontractors' liens arising from the investigatory activities.

6. Term. This Access Agreement and all obligations herein shall terminate upon the receipt by Owner from Cyprus Foote of written notice of the completion of the investigatory activities and radon mitigation.

7. Entire Agreement. This Access Agreement contains the entire agreement between the parties and is not an implicit admission of liability in any way. With respect to the subject matter herein, it supersedes any prior and contemporaneous understandings and agreements related to access, whether written or oral.

OWNER:

Name: _____

Date: _____

Signature _____

Date: _____

Signature _____

CYPRUS FOOTE MINERAL COMPANY

Date: _____

By: _____

EXHIBIT 8

EXHIBIT 8

CLASS PROPERTIES NOT EVALUATED

<u>Name</u>	<u>Address</u>	<u>City</u>	<u>Zip Code</u>	<u>Property Designation</u>
Bauman, Sherwood	354 Cowgill Lane	Cumberland	43732	N/A
Callahan, Allan	57463 Northstar Road	Pleasant City	43772	N/A
Carlson, Cecil	18378 Anderson Road	Kimbolton	43749	N/A
Clark, Harold	McClary Road	Lower Salem	45745	N/A
Cunningham, Rich	57624 North Star Road	Pleasant City	43772	O-33
Daymut, Don	310 S. 25th Street	Cambridge	43725	N/A
Duffy, Robert E.	4231 Peters Creek Road	Cambridge	43725	N/A
Durant, Beth	109 Eastview Drive	New Concord	43762	N/A
Kennedy, Donald	520 Harrison Road	Cambridge	43725	N/A
LaRue, Carl	63825 Arrowhead Road	Cambridge	43725	N/A
LaRue, William	60934 High Hill Road	Cambridge	43725	N/A
Lucas, Darlene	60145 Wintergreen Road	Pleasant City	43772	N/A
Lukehart, Karen and Don	59087 Marietta Road	Byesville	43723	N/A
Mahaffy, Tom	61783 Shaw Road	Cambridge	43725	N/A
Porter, Bob	6740 Matthew Lane	Cambridge	43725	N/A
Unknown Owner	225 Church Street	Senecaville	43780	O-54
Unknown Owner	1165 Steubenville Avenue	Cambridge	43725	N/A
Unknown Owner	917 Garfield Avenue	Cambridge	43725	N/A
Unknown Owner	Barret Hill Road	Cambridge	43725	N/A
Unknown Owner	57444 Boston Way Drive	Claysville	43725	O-03
Jrdak, Paul & Susan	115 Locust Street	Salesville	43778	N/A
Whiteley, Paul	116 Glass Avenue	Byesville	43723	N/A

EXHIBIT 9

EXHIBIT 9

PREVIOUS TEST ANALYSIS AND EVALUATION SPECIFICATIONS

1.0 FIELD EVALUATION PROCEDURES

1.1 General

Property evaluations will consist of gamma walkover surveys and the collection and analysis of discrete slag samples. The radionuclides of interest and analytical methods are provided in Tables 1 and 2, respectively.

1.2 Gamma Walkover Measurements

External gamma radiation walkover surveys will be performed using a NaI scintillation detector and a Ludlum Model 19 Micro R Meter, or the equivalent. Previous field studies indicate that the slag does not have a distinctive external gamma signature and that the principal radionuclide of concern is thorium 230. Therefore, gamma walkover surveys will consist of measurements at random rather than systematic locations within the area(s) of slag at each property. Survey areas will be based on the location of the slag at each property (e.g., driveway or patio). Readings also will be taken at each sample collection location. In accordance with NRC guidance in NUREG/CR-5849, exposure rates will be measured at 1 meter above the ground. Surface scans also will be performed. The surface scan readings will be taken on contact with the ground.

1.3 Evaluation of the Areal Extent and the Thickness of Slag and Cover Material

The areal extent and thickness of slag and any clean cover material that may exist will be evaluated at each property by visual inspection and observation, including use of shallow, hand-dug test pits or shallow hand auger borings.

1.4 Sampling of Slag Fill Material

A minimum of four (4) discrete samples of slag fill material will be taken at each property. For those properties where slag has been used in more than one application (e.g., driveway, building foundation, garage, patio), three (3) discrete samples will be taken from each application. Sampling locations will be biased towards areas with elevated external gamma readings, if such areas are identified. Otherwise, sampling locations will be randomly selected.

1.5 Sample Collection Protocol

Approximately 1 kg (2.2 pounds) of sample will be collected for laboratory analysis from each sample location. Upon collection, samples will be placed in plastic bags, sealed, labeled appropriately and maintained under chain-of-custody for shipment to a commercial laboratory for radiological analysis.

Sample collection utensils may include stainless steel shovels, hand augers, bowls, and spoons, or equivalent. To avoid cross-contamination, disposable sampling equipment will be employed or sampling equipment will be cleaned between each sample location.

Cleaning of sampling utensils will be performed in three stages. The first step will employ dry cleaning methods. Friable soil will be scraped or brushed from the equipment back into the hole from which the sample was collected. In the second step, the equipment will be held over the sample hole and rinsed with a light stream of distilled water from a spray bottle. The equipment will then be wiped with a damp paper towel until any remaining visible soil is removed. In the final step, the equipment will again be held over the sample hole and will receive a final rinse from the spray bottle. Following cleaning, equipment will be stored in plastic bags or covered with plastic sheeting if not immediately reused.

2.0 LABORATORY TESTING OF SAMPLES

Samples of slag fill material will be tested for the radionuclides of interest listed in Table 1 at a commercial analytical laboratory. All analytical protocols will follow written procedures and

will be consistent with current industry accepted practices. Radionuclide testing parameters, analytical methods and detection limit goals are shown in Table 2. Each sample will be analyzed for photon emitting radionuclides using gamma spectrometry. In addition, each sample will be analyzed for isotopic thorium using alpha spectrometry. All results will be reported in picoCuries per gram (pCi/g) of material.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Field Instrumentation

In accordance with NRC guidance in NUREG/CR-5849, all field instrumentation will be calibrated against certified radionuclide sources traceable to the National Institute of Standards and Technology (NIST) prior to use during this investigation. Certificates will be issued and maintained for all field survey equipment. Background and response checks will be performed on field instrumentation at the beginning and end of each day in the field, or at the beginning and end of their use at each property. In accordance with NRC guidance in NUREG/CR-5849, response checks must agree within $\pm 20\%$ of the calibrated efficiency. If an instrument fails a response check, it will be tagged out-of-service and replaced with a new instrument. All data from a failed instrument will be rechecked up to the last source check. Check sources used in the field will be NIST traceable, and certificates will be maintained for the check sources. Documentation will be maintained for all background and response checks.

3.2 Field Measurements

Duplicate radiation survey measurements will be taken on 1 in every 20 measurements performed. Duplicate measurements will be marked as "D" or "Dup" on the appropriate form. Field data sheets and calculations will undergo an independent peer review by personnel with relevant technical qualifications.

3.3 Sample and Document Custody Procedures

Sample custody will be initiated in the field at the time of sample collection. The field sampling team leader will ensure that samples will be identified by sample labels with the following information: unique sample identification number, date and time of sampling, sampling location, analysis and any additional relevant comments. Field chain-of-custody forms containing the same information will be completed for each set of samples and will be signed by the field team sampling leader or sampling technician. The original chain-of-custody form will be shipped to the laboratory with the samples. Laboratory personnel will acknowledge receipt of the sample by adding their signature and by entering the date and the time the samples were received.

3.4 Laboratory Quality Control

All radionuclide analyses will be performed under a fully implemented quality assurance program that addresses all aspects of the analytical process. Laboratory Quality Control (QC) samples will include spiked, blank and duplicate samples. QC samples will be analyzed at a rate of 5 % of the total number of samples or one per analytical batch. All data will receive a thorough technical and Quality Assurance review by the laboratory prior to their release.

Table 1. Radionuclides of Interest for Property Evaluation

Decay Series	Radionuclide
Uranium (Uranium 238)	Uranium 238
	Uranium 234
	Thorium 230
	Radium 226
Thorium (Thorium 232)	Thorium 232
	Thorium 228
Actinium (Uranium 235)	Uranium 235
	Protactinium 231
	Thorium 227
	Radium 223

Table 2. Radionuclide Testing Parameters, Analytical Methods, and Detection Limits

Parameter	Analytical Method	Detection Limit Goals ¹
Isotopic Thorium (Th-228, Th-230, Th-232)	Alpha Spectrometry, NAS NS 3004	0.1 pCi/gram
Isotopic Uranium ² U-234, U-235, U-238	Gamma Spectrometry, HASL 300 4.4.2.5	1 pCi/gram
Radium 226 ²	Gamma Spectrometry, HASL 300 4.4.2.5	1 pCi/gram
Protactinium 231	Gamma Spectrometry, HASL 300 4.4.2.5	1 pCi/gram
Thorium 227	Gamma Spectrometry, HASL 300 4.4.2.5	1 pCi/gram
Radium 223	Gamma Spectrometry, HASL 300 4.4.2.5	1 pCi/gram

¹Detection limits depend on sample size and interferences from other radionuclides in the sample. Values listed in this table represent the detection limit goals for these radionuclides.

²Analysis for these radionuclides assumes secular equilibrium among members of the decay series.

EXHIBIT

PREVIOUS DOSE EVALUATION SPECIFICATIONS

**GUIDELINES FOR RADIONUCLIDES IN SLAG FILL MATERIAL
AT RESIDENTIAL PROPERTIES IN CAMBRIDGE, OHIO**

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1.0 INTRODUCTION

1.1 BACKGROUND

Slag from metal production operations has allegedly been used as fill material on residential properties in the Cambridge, Ohio area. Studies have been performed to determine the identities and concentrations of radionuclides contained in the slag (Vitkus 1994; Woodward-Clyde 1995a, 1995b). This report presents the derivation of above-background residual concentrations, or guidelines, for radionuclides identified as being present in slag on residential properties. Guidelines are derived for a specific land-use scenario, exposure pathways, and environmental exposure parameters to ensure that individual radiation dose limits will not be exceeded. Residential properties having radionuclides at concentrations that are less than the guidelines do not require remediation.

1.2 APPROACH

Potential radiation doses from radionuclides in soil, or material such as slag contained in soil, are proportional to the concentration of each radionuclide, with the proportionality depending on the exposure scenario, pathways, and parameters. The evaluation of the potential radiation doses from soil/slag to humans is performed with an exposure pathway analysis and dose assessment (Till and Meyer 1983).

Soil concentration guidelines are customarily derived with models that simplify the exposure assessment process. Several models are available for determining the relationship between radionuclide concentrations in soil and the associated radiation dose. The computer code, RESRAD 5.19, developed by the U.S. Department of Energy to derive site-specific soil guidelines (Yu 1993), has been used in this study by considering slag fill material as soil. Site-specific modeling parameters have been used when available; otherwise, default parameters recommended in the RESRAD code were used. Guidelines are derived for thorium-230 (Th-230), radium-226 (Ra-226), protactinium-231 (Pa-231), and other radionuclides in the natural decay series.

1.3 REPORT ORGANIZATION

The method for deriving concentration guidelines and a description of the model pathways and parameters are presented in Section 2.0. Guidelines for radionuclides in slag in the Cambridge, Ohio area are presented in Section 3.0. Considerations for mixtures of radionuclides are given in Section 4.0. Conclusions of the report are presented in Section 5.0. Specific details of the calculations are given in Appendices A and B.

2.0 DERIVATION OF SLAG GUIDELINES

2.1 RESRAD CODE

The microcomputer code, RESRAD, was first developed in 1989 by the U.S. Department of Energy for deriving site-specific guidelines for radionuclides in soil (Yu 1993). The code has been revised and improved such that its present version, RESRAD 5.19, is widely used by Federal and state regulators for determining acceptable residual radionuclide concentrations at sites throughout the U.S. The code calculates the radiation dose from each specified radionuclide concentration in soil for each of numerous exposure pathways, using environmental transport and uptake models that are generally accepted in the radiation protection field and consensus radiation dose conversion factors. The total radiation dose is then calculated from all pathways for each radionuclide. The radiation "dose factor" for each radionuclide is defined as the total radiation dose from all pathways per unit soil concentration. The soil guideline for a specific radionuclide is calculated by dividing the individual dose limit by the dose factor for that radionuclide. Details of the RESRAD code are given in the report, "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0" (Yu 1993). In this study, the calculation methods are applied to slag as though it is soil, so that potential radiation doses are not underestimated. In fact, since the material is slag and not soil, the calculated doses are in all likelihood overestimated.

2.2 EXPOSURE SCENARIO

The hypothetical exposure scenario that presents the greatest potential long-term dose is the adult resident farmer. Exposure of permanent residents is more likely to be long-term and will involve exposures through a greater number of pathways. This scenario results in the most restrictive (lowest) radionuclide guidelines for future potential long-term exposures and, therefore, is the scenario that is used in this study. The assumptions made for this scenario are conservative and are made for the purposes of establishing guidelines for action, not to demonstrate a guideline where harm may result or damage may occur.

2.3 EXPOSURE PATHWAYS

Potential exposure pathways that are assumed for derivation of the slag guidelines are:

- external radiation exposure from slag on the ground surface,
- inhalation of resuspended dust,
- inhalation of radon and radon progeny,
- ingestion of food crops,
- ingestion of meat and milk,

- incidental ingestion of slag,
- ingestion of drinking water, and
- ingestion of fish.

All of these pathways, under certain circumstances, could theoretically be applicable for exposure from contaminated soil; however, the relevance and applicability of many of these pathways for exposure to slag is questionable. For this study, an extremely conservative assumption of potential exposure to all of these pathways is made. A discussion of the impact of these pathways for overestimation of radiation doses (and, hence, for underestimation of guidelines) is presented in the next section.

2.4 EXPOSURE PARAMETERS

Specific values for exposure parameters were determined for each exposure pathway. Site-specific parameters were selected whenever possible. Otherwise, standard default values for exposure parameters were used. A summary of exposure parameters is given in Appendix A. Parameters used for each RESRAD calculation are listed in Appendix B.

No parameters were selected that could lead to an underestimation of the radiation dose. Several assumed parameters, however, led to an overestimation of radiation doses. The following are examples of assumptions that lead to more restrictive concentration guidelines:

- radiation doses were modeled for a period of 1000 years, with no source dilution or decrease in source term by erosion;
- the most restrictive concentration guideline for each radionuclide calculated for any time during the 1000 years was assumed to be the guideline for the entire period (The time at which the most restrictive concentration occurs is not the same for all radionuclides.);
- slag particles were assumed to be resuspended by wind erosion followed by inhalation and deposition onto crops and forage, with no decrease in the amount of slag;
- resuspended particles were assumed to be respirable, with a diameter of one micron, leading to the greatest inhalation dose factor;
- slag particles were assumed to be ingested at a rate of 0.1 gram per day;
- uptake following ingestion was assumed to occur as though the particles were an extremely fine grained powder (The assumptions regarding small particle sizes for

inhalation and incidental ingestion were made even though the slag is known to be extremely hard and present as gravel-, or rock-sized stones.);

- slag was assumed to constitute the entirety of soil in which crops and forage were grown (This is an unrealistic overestimation of the role of slag for plant growth, because slag does not provide organic nutrients or nearly any of the elements essential for plant survival. In order for plant growth to occur, slag would constitute only a fraction of the total volume of soil);
- all drinking water, irrigation water, and livestock water was assumed to come from wells at the site;
- depletion of the source term as a result of radionuclide transport to the groundwater was not included in the calculations; and
- a radon emanation fraction of 0.01 (from slag containing Ra-226) was assumed for calculating the radiation doses from radon and radon progeny [This emanation fraction is consistent with measurement results for slag (Woodward-Clyde 1995a). Radon emanation from slag has been reported to be greatly limited by the dense nature of the slag, inhibiting radon diffusion from within the slag and leading to an emanation fraction less than 0.01 (UNSCEAR 1988). Use of the higher emanation fraction leads to a higher value of the calculated dose from radon and radon progeny.]

2.5 INDIVIDUAL DOSE LIMIT

The radiation dose used in derivation of guidelines for slag is the effective dose equivalent from external radiation exposure plus the committed effective dose equivalent from internally-deposited radionuclides (NCRP 1984). An annual radiation dose limit of 500 millirem (mrem) was selected as the basis for calculating guidelines. This individual dose limit has been recommended by the National Council on Radiation Protection and Measurements (NCRP) for intervention at sites previously impacted with technologically-enhanced, naturally-occurring radioactive materials (NCRP 1993).

2.6 CALCULATION OF GUIDELINES FOR SLAG

As noted previously, the RESRAD code is applied to slag as though slag comprises the soil in the affected areas on each property. This application ensures that the potential radiation doses from slag are not underestimated. The guideline for each radionuclide in slag is calculated by dividing the individual dose limit by the dose factor for the radionuclide as determined from the RESRAD code. Guidelines derived for the specific radionuclides identified in slag are presented in the following section.

3.0 GUIDELINES FOR RADIONUCLIDES IN SLAG

RESRAD calculations have been made for six (6) separate areas of contamination for each of five (5) thicknesses. The areas selected for the study include one (1) square meter (m^2), 10 m^2 , 50 m^2 , 100 m^2 , 500 m^2 , and 1000 m^2 . The thicknesses of each contaminated area include 0.15 m, 0.30 m, 0.60 m, 1.00 m, and 2.00 m, with no cover material. Therefore, there were 30 separate applications of the RESRAD code for each radionuclide. Guidelines for the allowable level of each radionuclide identified in slag at concentrations above natural background levels are presented in this section. Each guideline is given in units of picocuries per gram (pCi/g) above natural background concentrations. The detailed report of an example RESRAD computational run is given in Appendix B.

3.1 THORIUM-230

Guidelines for Th-230 in slag for each area and thickness are listed in Table 3-1. In most cases, the guideline (lowest value) is calculated to occur at the end of the 1000-year period of the study, because of the radioactive ingrowth of Ra-226 from Th-230 and because the quantity of slag is not assumed to decrease over time (i.e., no erosion is assumed).

TABLE 3-1
GUIDELINES FOR TH-230 IN SLAG

Area (m^2)	Thickness of Slag				
	0.15 m (pCi/g)	0.30 m (pCi/g)	0.60 m (pCi/g)	1.00 m (pCi/g)	2.00 m (pCi/g)
1	23810	17880	13340	11550	8766
10	5176	2964	1995	1657	1153
50	2124	1123	723	583	348
100	1731	574	557	437	224
500	1089	510	275	194	118
1000	841	369	182	122	83

These results are shown on Figure 3-1. As expected, the larger the area and thickness of contamination, the lower the value of the guideline. Residential properties having radionuclides at above-background concentrations that are less than the guidelines do not require remediation.

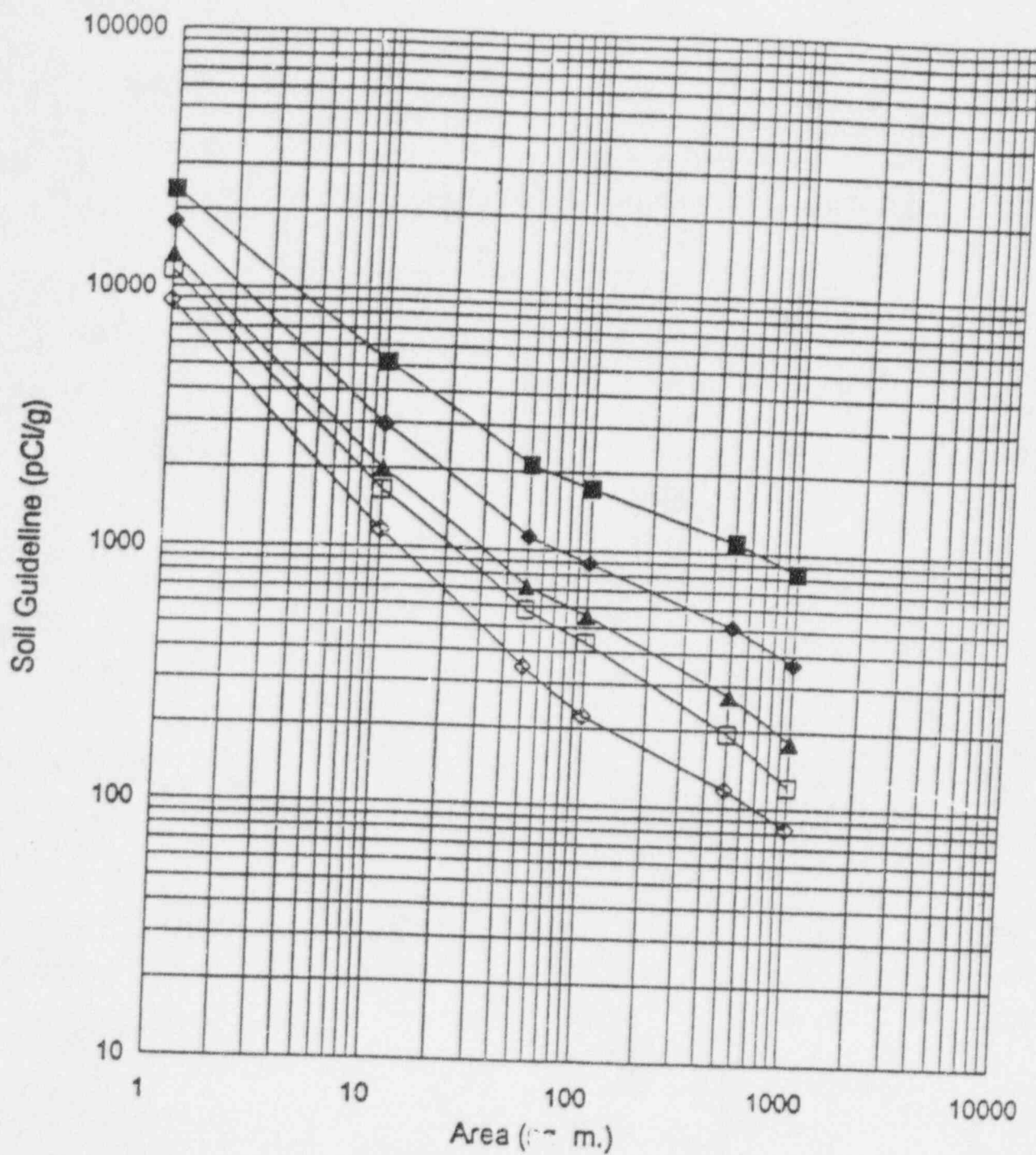
3.2 RADIUM-226

Guidelines for Ra-226 in slag for each area and thickness considered in the study are listed in Table 3-2. With a radioactive half-life of 1600 years and numerous alpha-, beta-, and gamma-emitting progeny (Kocher 1981), guidelines for Ra-226 are much lower than the guidelines for Th-230. Short-lived progeny are assumed to reach radioactive equilibrium in the slag. External radiation exposure, ingestion of food crops, and incidental ingestion of slag/soil are the most important potential exposure pathways for Ra-226. These guidelines represent the lowest values during the 1000-year study period, and are calculated to occur within 100 years.

TABLE 3-2
GUIDELINES FOR RA-226 IN SLAG

Area (m ²)	Thickness of Slag				
	0.15 m (pCi/g)	0.30 m (pCi/g)	0.60 m (pCi/g)	1.00 m (pCi/g)	2.00 m (pCi/g)
1	6051	5494	5358	5207	3952
10	608	551	539	525	398
50	215	194	186	176	115
100	174	156	144	132	74
500	113	93	72	58	39
1000	90	68	48	37	28

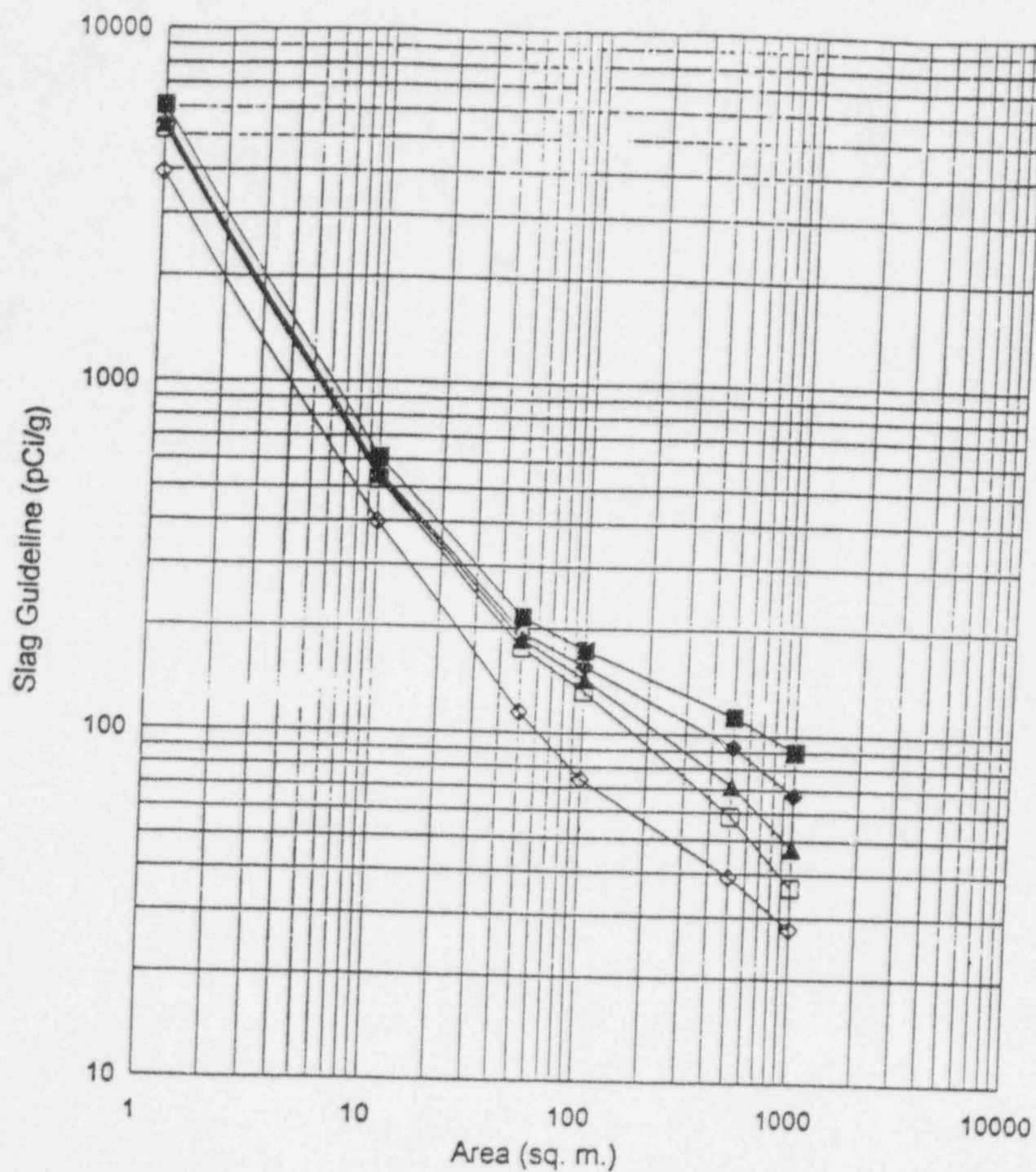
These results are shown on Figure 3-2. As with other radionuclides, the larger the area and thickness of contamination, the lower the value of the guideline.



■ 15 cm thick ◆ 30 cm thick ▲ 60 cm thick □ 1 m thick ◇ 2 m thick

Minimum Value for 500 mrem/year
Calculated by RESRAD Computer Code - V. 5.19

FIGURE 3-1 SLAG GUIDELINES FOR THORIUM-230



■ 15 cm thick ◆ 30 cm thick ▲ 60 cm thick □ 1 m thick ◇ 2 m thick

Minimum Value for 500 mrem/year
Calculated by RESRAD Computer Code - V. 5.19

FIGURE 3-2 SLAG GUIDELINES FOR RADIUM-226

3.3 PROTACTINIUM-231

Protactinium-231 is a long-lived decay product of uranium-235 (U-235), in the actinium series (one of the three naturally-occurring radioactive decay series). With one exception, the progeny of Pa-231 have half-lives less than 20 days; the half-life of actinium-227 (Ac-227) is approximately 22 years (Kocher 1981). Inhalation of resuspended dust and external exposure are the predominant exposure pathways that lead to the relatively low guidelines for Pa-231. These guidelines (lowest values) are calculated to occur within 150 years.

TABLE 3-3
GUIDELINES FOR PA-231 IN SLAG

Area (m ²)	Thickness of Slag				
	0.15 m (pCi/g)	0.30 m (pCi/g)	0.60 m (pCi/g)	1.00 m (pCi/g)	2.00 m (pCi/g)
1	1504	1316	1204	1150	1113
10	631	541	481	446	433
50	376	309	257	225	218
100	314	248	195	163	158
500	180	123	79	58	57
1000	125	79	47	33	32

These results are shown on Figure 3-3. Unlike guidelines for Ra-226, the guidelines for Pa-231 do not decrease appreciably with thickness (for thicknesses greater than approximately 1 m) because much of the dose is from inhalation of resuspended dust (a surface effect) and because the external dose is from relatively low-energy gamma rays that are readily attenuated by the soil/slag.

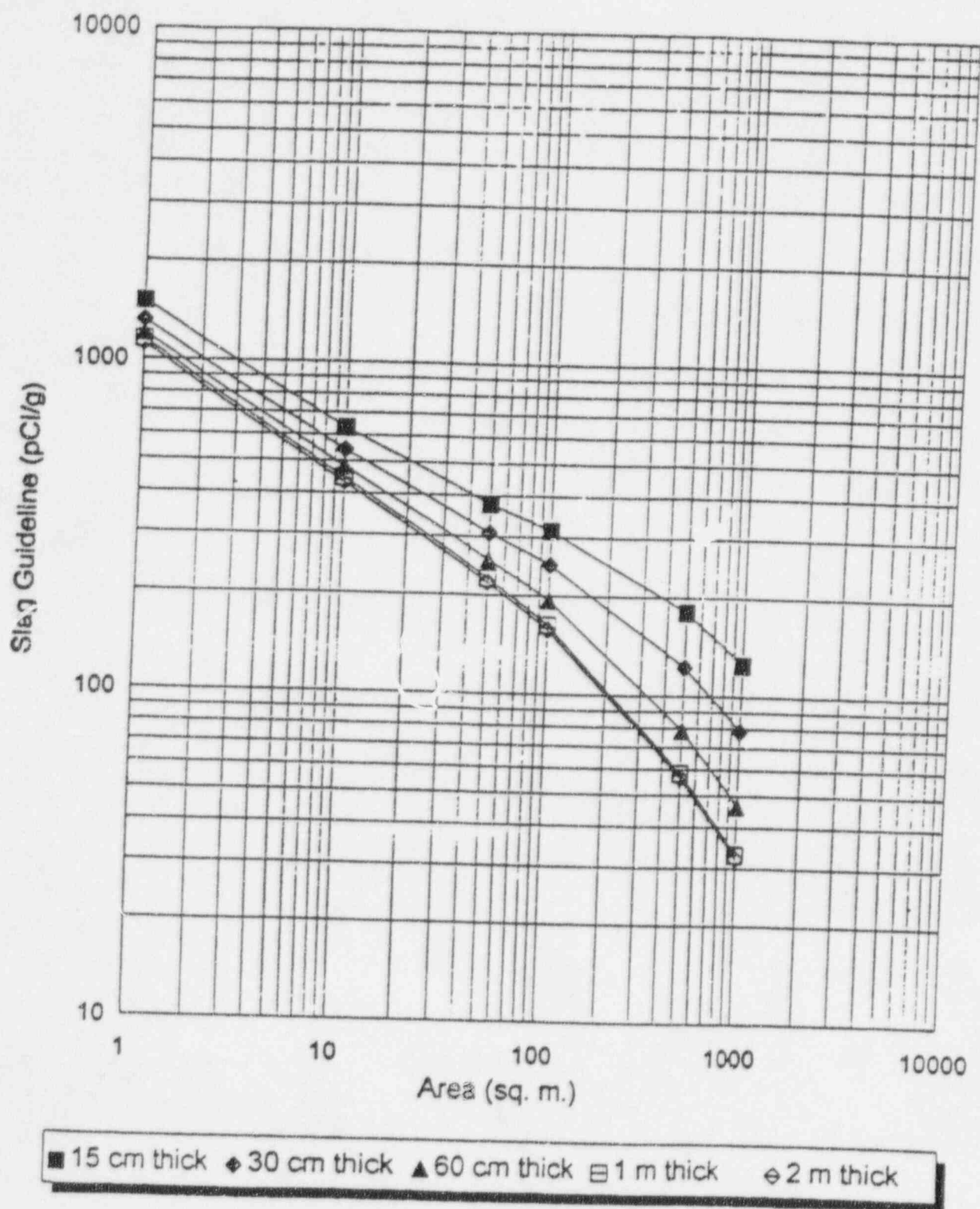


FIGURE 3-3 SLAG GUIDELINES FOR PROTACTINIUM-231

3.4 OTHER RADIONUCLIDES

In addition to the three (3) radionuclides listed above, guidelines have been calculated for three (3) other long-lived radionuclides found in slag in concentrations exceeding natural background levels. These radionuclides are uranium-235 (U-235), uranium-238 (U-238), and thorium-232 (Th-232). Guidelines for U-235 and U-238 are much higher (less restrictive) than the guidelines for Th-230, Ra-226, and Pa-231. For example, the guidelines for U-235 and U-238 in an area of 1000 m² at a thickness of 2.00 m are 311 pCi/g and 350 pCi/g, respectively.

Guidelines for Th-232 in slag for each area and thickness are listed in Table 3-4. Short-lived progeny are assumed to reach radioactive equilibrium in the slag. Inhalation of resuspended dust containing Th-232 from slag and external radiation exposure from Th-232 progeny in slag are the most significant exposure pathways. These guidelines represent the lowest values during the 1000-year study period, and are calculated to occur within 100 years.

TABLE 3-4
GUIDELINES FOR TH-232 IN SLAG

Area (m ²)	Thickness of Slag				
	0.15 m (pCi/g)	0.30 m (pCi/g)	0.60 m (pCi/g)	1.00 m (pCi/g)	2.00 m (pCi/g)
1	2488	2247	2172	2147	2140
10	418	356	339	334	332
50	162	136	128	125	124
100	133	111	103	99	99
500	88	71	62	56	56
1000	72	56	47	41	41

4.0 GUIDELINES FOR MIXTURES OF RADIONUCLIDES

Guidelines have been derived for each radionuclide based on the individual dose limit. Whenever two or more radionuclides are present in slag at concentrations exceeding natural background levels at a site, application of the guideline for each radionuclide could cause the individual dose limit to be exceeded, because the total radiation dose is the sum of the doses from all radionuclides at the site. In order that the individual dose limit is not exceeded at a site having multiple radionuclides in slag, a method of accounting for multiple radionuclides is needed. The conventional approach for deriving concentration limits for multiple radionuclides is often referred to as the "sum of fractions" method.

With the sum of fractions method for multiple radionuclides in slag, the ratio of the above-background component of the measured radionuclide concentration in slag to the respective guideline is calculated for each radionuclide exceeding background levels. The ratios, or fractions, for the radionuclides are then summed. If the sum of the fractions exceeds unity (1), the residential property is considered for remediation.

The greatest limitation in applying this method for guidelines for multiple radionuclides is that guidelines have been determined for the time that gives the most restrictive (lowest) concentration value. These times differ for each radionuclide, thereby causing the application of the method to be overly conservative (restrictive). Nevertheless, the method may be applied to evaluate the need for remediation of residential properties having multiple radionuclides in slag, providing an additional level of protection.

5.0 CONCLUSIONS

Residual concentrations (guidelines) for radionuclides in slag have been derived with the widely-accepted calculational code, RESRAD. These guidelines are dependent on the area of contamination and on the thickness of contamination. Tables of guideline values for Th-230, Ra-226, Pa-231, and Th-232, for thirty (30) combinations of areas and thicknesses are presented in Section 3.0.

The individual dose limit recommended by the National Council on Radiation Protection and Measurements for intervention at sites previously impacted with technologically-enhanced, naturally occurring radioactive materials was selected as the basis for calculating guidelines (NCRP 1993). That dose limit, 500 mrem per year, is the sum of the effective radiation dose equivalent from external exposure and the committed effective dose equivalent from internally deposited radionuclides (excluding radon and radon progeny).

Each guideline has been derived for the adult resident farmer scenario, resulting in the most restrictive long-term guidelines. In an overly conservative assumption, slag has been considered to comprise soil in the areas and thicknesses specified. Exposure pathways applicable for exposure to contaminated soil were assumed for exposure to slag. Exposure assessment parameters that led to conservative (lower) guidelines were used in deriving slag guidelines.

Each residential property that is determined to have radionuclide concentrations in slag, exceeding natural background concentrations, can be evaluated with respect to the relevant guidelines to determine whether remediation is warranted. The net (background subtracted) concentration of each radionuclide in representative samples from each property can be compared to the guideline for the respective radionuclide in the affected area and thickness. For multiple radionuclides, the sum of the fractions of the ratios of the measured concentrations and their respective guidelines, is calculated. Remediation may be considered for any residential property for which the measured above-background concentration exceeds the relevant guideline or for which the sum of fractions of concentration ratios exceed unity (1). Residential properties having radionuclides at above-background concentrations that are less than the guidelines, or for which the sum of fractions is less than unity (1), do not require remediation.

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Category/Item		Premise or Parameter Value	Justification
Water independent Exposure Pathways	5	<u>External radiation from in situ slag = ACTIVE</u> - Area of contaminated zone = 1, 10, 50, 100, 500, 1000 m ² . - Thickness of contaminated zone = 0.15, 0.30, 0.60, 1.0, 2.0 m. - Length parallel to aquifer flow = 100 m. - Radiation dose limit = 500 mrem/y. - Elapsed time since waste placement = 0. - Calculation points in time = 0, 10, 30, 70, 100, 200, 300, 500, 750, 1000 y.	Exposure pathways marked "ACTIVE" are taken into account in the derivation of soil guidelines because the dose contribution from these pathways is expected to be significant. - Range of areas per offsite property. - Range of thicknesses per offsite property. - RESRAD default. - Assumption. - A value > 0 is used if groundwater concentrations are to be input, see pg 60. - Assumed time points of interest spanning 1000 y. RESRAD always includes 0.
	6	<u>External radiation from redeposition of slag from the air = MINOR</u>	In the RESRAD code, minor exposure pathways are not taken into account in deriving soil guidelines because the dose contribution is expected to be insignificant.
	7	<u>External exposure from contaminated water = MINOR</u>	In the RESRAD code, minor exposure pathways are not taken into account in deriving soil guidelines because the dose contribution is expected to be insignificant.
	8	<u>External exposure from contaminated resuspended dust = MINOR</u>	In the RESRAD code, minor exposure pathways are not taken into account in deriving soil guidelines because the dose contribution is expected to be insignificant.
	9	<u>External exposure from short-lived airborne radon progeny = MINOR</u>	In the RESRAD code, minor exposure pathways are not taken into account in deriving soil guidelines because the dose contribution is expected to be insignificant.

Category/Item	Premise or Parameter Value	Justification
10	<u>Inhalation of resuspended dust = ACTIVE</u> - Inhalation rate = 8400 m ³ /y. - Mass loading to air for inhalation = 5.5×10^{-5} g/m ³ . - Dilution length for airborne dust, inhalation = 3 m. - Exposure duration = 30 y. - Shielding factor, inhalation = 0.50 - Shielding factor, external gamma = 0.33 - Fraction of time spent indoors = 0.55 - Fraction of time spent outdoors onsite = 0.20 - Shape factor, external gamma = 1	- RESRAD default. - Sanford Cohen reported value based on air quality data for Cambridge, Ohio. - RESRAD default. - RESRAD default. - Sanford Cohen reported as NRC value. - Sanford Cohen reported as NRC value. - Sanford Cohen reported as NRC value. - Sanford Cohen reported as NRC value. - RESRAD default.
11	<u>Inhalation of indoor & outdoor radon = ACTIVE</u>	
12	<u>Ingestion of plant foods contaminated via root uptake from soil, foliar uptake from deposition of dust = ACTIVE</u> - Mass loading for foliar deposition = 1×10^{-4} g/m ² . - Depth of soil mixing layer = 0.15 m. - Depth of roots = 0.90 m.	The plant foods pathway will be the dominant and most frequent dose contributing food pathway. - RESRAD default. - RESRAD default. - RESRAD default.
13	<u>Ingestion of meat and milk contaminated by livestock fodder contaminated via root uptake from soil, foliar uptake from deposition of dust = ACTIVE</u>	Contributions from meat and milk will be smaller than from plant foods but will not be insignificant.
14	<u>Ingestion of meat and milk contaminated by soil ingested by livestock = ACTIVE</u> - Livestock soil intake rate = 0.50 kg/d.	- RESRAD default.
15	<u>Incidental ingestion of contaminated soil = ACTIVE</u> - Soil ingestion rate, human = 36.5 g/y.	Incidental ingestion will occur when eating and drinking while working outdoors. - RESRAD default.

Category/Item		Premise or Parameter Value	Justification
Water Dependent Exposure Pathways	16	<u>Ingestion of contaminated water as drinking water = ACTIVE</u> - Drinking water intake, human = 510 L/y. - Contaminated fraction of drinking water = 1.0 - Storage time for well water = 1 d. - Drinking water fraction from groundwater (vs. surf. water) = 1.0 - Household water fraction from groundwater (vs. Surf. water) = 1.0	- RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default.
	17	<u>Ingestion of plant foods contaminated via root uptake from irrigation water. foliar uptake from irrigation water = ACTIVE</u> - Fruits, vegetables, and grain consumption = 160 kg/y. - Storage time for fruits, vegetables, and grain = 14 d. - Leafy vegetable consumption = 14 kg/y. - Storage time for leafy vegetables = 1.0 d. - Contaminated fraction of irrigation water = 1.0 - Contaminated fraction of plant foods = -1 - Irrigation fraction from groundwater (vs. surf. water) = 1.0	The plant foods pathway will be the dominant and most frequent dose contributing food pathway, especially if contaminated water is used for irrigation. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default (Auto-calc fraction based on area factor method, App D.2.1.2). - RESRAD default.
	18	<u>Ingestion of meat and milk contaminated by livestock fodder contaminated via root uptake from irrigation water. foliar uptake from irrigation water = ACTIVE</u> - Milk consumption = 92 L/y. - Storage time for milk = 1.0 d. - Meat and poultry consumption = 63 kg/y. - Storage time for meat and poultry = 20 d. - Contaminated fraction of meat = -1 - Contaminated fraction of milk = -1 - Livestock fodder intake for meat = 68 kg/d. - Livestock fodder intake for milk = 55 kg/d. - Storage time for livestock fodder = 45 d.	Contributions from meat and milk will be smaller than from plant foods but will not be insignificant. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default (Auto-calc fraction based on area factor method, App D.2.1.2). - RESRAD default (Auto-calc fraction based on area factor method, App D.2.1.2). - RESRAD default. - RESRAD default. - RESRAD default.

Category/Item		Premise or Parameter Value	Justification
	19	<u>Ingestion of meat and milk contaminated by livestock drinking water</u> = ACTIVE - Contaminated fraction of livestock water = 1.0 - Livestock water intake for meat = 50 L/d. - Livestock water intake for milk = 160 L/d. - Livestock water fraction from groundwater (vs. surf. water) = 1.0	- RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default.
	20	<u>Ingestion of fish and other seafood from a nearby contaminated pond</u> = ACTIVE - Fish consumption = 5.4 kg/y. - Other seafood consumption = 0.90 kg/y. - Storage time for fish and other seafood = 7.0 d. - Storage time for surface water = 1.0 d. - Contaminated fraction of aquatic food = 0.50	The aquatic food pathway should occur only where the topography and soil characteristics of the property are favorable for a pond. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default. - RESRAD default.

APPENDIX A (CONT'D)

PARAMETER VALUES FOR GROUNDWATER MODEL

Parameter Value	Justification
- Cover depth = 0 m.	- Conservative assumption.
- Density of contaminated zone = 2.3 g/cm ³ .	- Assumption.
- Contaminated zone erosion rate = 0.0 m/y.	- Assumption.
- Contaminated zone total porosity = 0.4	- RESRAD default.
- Contaminated zone effective porosity = 0.2	- RESRAD default.
- Contaminated zone hydraulic conductivity = 10 m/y.	- RESRAD default.
- Contaminated zone b parameter = 5.3	- RESRAD default.
- Evapotranspiration coefficient = 0.5	- RESRAD default.
- Precipitation = 1 m/y.	- RESRAD default.
- Irrigation = 0.2 m/y.	- RESRAD default.
- Irrigation mode = 0 for overhead irrigation.	- Assumption.
- Runoff coefficient 0.2	- RESRAD default.
- Watershed area for nearby stream/pond = 1×10^6 m ² .	- RESRAD default.
- Accuracy for water/soil computation = 0.001	- RESRAD default.
- Density of saturated zone = 1.5 g/cm ³ .	- RESRAD default.
- Saturated zone total porosity = 0.4	- RESRAD default.
- Saturated zone effective porosity = 0.2	- RESRAD default.
- Saturated zone hydraulic conductivity = 100 m/y.	- RESRAD default.
- Saturated zone hydraulic gradient = 0.02	- RESRAD default.
- Saturated zone b parameter = 5.3	- RESRAD default.
- Water table drop rate = 0.001 m/y.	- RESRAD default.
- Well pump intake depth = 10 m below water table.	- RESRAD default.
- Model: Nondispersion or Mass balance = ND.	- RESRAD default, see pg 65.
- Well pumping rate = 250 m ³ /y.	- RESRAD default.
- Number of unsaturated zone strata = 1	- Assumption.
- Unsaturated zone thickness = 1 m.	- Sanford Cohen reported as NRC value in CR-5512.
- Unsaturated zone soil density = 1.5 g/cm ³ .	- RESRAD default.
- Unsaturated zone total porosity = 0.4	- RESRAD default.
- Unsaturated zone effective porosity = 0.2	- RESRAD default.
- Unsaturated zone soil-specific b parameter = 5.3	- RESRAD default.
- Unsaturated zone hydraulic conductivity = 10 m/y.	- RESRAD default.
<u>Distribution coefficients for Th-230, Th-232, Th-228</u>	
- Contaminated zone = 3200 cm ³ /g.	- Sheppard and Thibault, 1990; conservative value.
- Unsaturated zone = 3200 cm ³ /g.	- Sheppard and Thibault, 1990; conservative value.
- Saturated zone = 3200 cm ³ /g.	- Sheppard and Thibault, 1990; conservative value.
- Leach rate = 0 y ⁻¹ .	- RESRAD default.
- Solubility constant = 0	- RESRAD default.
<u>Distribution coefficients for Pb-210</u>	
- Contaminated zone = 270 cm ³ /g.	- Sheppard and Thibault, 1990; conservative value.
- Unsaturated zone = 270 cm ³ /g.	- Sheppard and Thibault, 1990; conservative value.
- Saturated zone = 270 cm ³ /g.	- Sheppard and Thibault, 1990; conservative value.
- Leach rate = 0 y ⁻¹ .	- RESRAD default.
- Solubility constant = 0	- RESRAD default.

APPENDIX A (CONT'D.)

Distribution coefficients for Ra-226

- Contaminated zone = 500 cm³/g.
- Unsaturated zone = 500 cm³/g.
- Saturated zone = 500 cm³/g.
- Leach rate = 0 y⁻¹.
- Solubility constant = 0

- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- RESRAD default.
- RESRAD default.

Distribution coefficients for U-234, U-235, U-238

- Contaminated zone = 35 cm³/g.
- Unsaturated zone = 35 cm³/g.
- Saturated zone = 35 cm³/g.
- Leach rate = 0 y⁻¹.
- Solubility constant = 0

- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- RESRAD default.
- RESRAD default.

Distribution coefficients for Pa-231

- Contaminated zone = 550 cm³/g.
- Unsaturated zone = 550 cm³/g.
- Saturated zone = 550 cm³/g.
- Leach rate = 0 y⁻¹.
- Solubility constant = 0

- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- RESRAD default.
- RESRAD default.

Distribution coefficients for Ac-227

- Contaminated zone = 450 cm³/g.
- Unsaturated zone = 450 cm³/g.
- Saturated zone = 450 cm³/g.
- Leach rate = 0 y⁻¹.
- Solubility constant = 0

- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- Sheppard and Thibault, 1990; conservative value.
- RESRAD default.
- RESRAD default.

PARAMETER VALUES FOR RADON MODEL

Parameter Value

- Thickness of building foundation = 0.15 m.
- Bulk density of building foundation = 2.4 g/cm³.
- Total porosity of cover material = NA.
- Total porosity of building foundation = 0.1.
- Volumetric water content of cover material = NA.
- Volumetric water content of foundation = 0.03.
- Diffus. coeff. for radon gas cover material = NA.
- Diffus. coeff. radon gas foundat. material = 3×10^{-7} m²/sec.
- Diffus. coeff. radon gas contam. zone soil = 2×10^{-6} m²/sec.
- Radon vertical mixing dimension (outdoors) = 2 m.
- Average annual wind speed = 2 m/sec.
- Average building air exchange rate = 0.5 hr⁻¹.
- Interior height of a building room = 2.5 m.
- Building interior area factor = 0.
- Building depth below ground surface = 1.0 m.
- Emanating power of Rn-222 gas = 0.01
- Emanating power of Rn-222 gas = 0.0001 - slag
- Emanating power of Rn-220 gas = 0
- Emanating power of Rn-220 gas = 0

Justification

- RESRAD default.
- RESRAD default.
- Assume no cover.
- RESRAD default.
- Assume no cover.
- RESRAD default.
- Assume no cover.
- RESRAD default (pg 75: can use auto-calc).
- RESRAD default (pg 75: can use auto-calc).
- RESRAD default.
- RESRAD default.
- RESRAD default.
- RESRAD default.
- RESRAD default (Auto-calc factor, see pg 75).
- RESRAD default (pg 76: can use negative value).
- RESRAD lowest value accepted.
- UNSCEAR, 1988; Table 16, pg. 104.
- RESRAD lowest value accepted.
- UNSCEAR, 1988; p. 61, short Rn-220 diff. length.

APPENDIX B

DETAILED PRINTOUTS OF RESRAD CALCULATIONS

(area = 1000 m²; thickness = 2 m)

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Dose Conversion Factor (and Related) Parameter Summary
File: DCFAC.GIN

Menu	Parameter	Current Value	Default	Parameter Name
A-1	Ground external gamma, volume DCF's, (aRem/yr)/(pCi/cm**3):			
A-1	Ac-227+D, soil density = 1.0 g/cm**3	2.740E+00	2.740E+00	DCF1(1,1)
A-1	Ac-227+D, soil density = 1.8 g/cm**3	1.520E+00	1.520E+00	DCF1(1,2)
A-1	Pu-231, soil density = 1.0 g/cm**3	2.210E-01	2.210E-01	DCF1(2,1)
A-1	Pu-231, soil density = 1.8 g/cm**3	1.210E-01	1.210E-01	DCF1(2,2)
A-1	Pb-210+D, soil density = 1.0 g/cm**3	4.870E-03	4.870E-03	DCF1(3,1)
A-1	Pb-210+D, soil density = 1.8 g/cm**3	2.310E-03	2.310E-03	DCF1(3,2)
A-1	Ra-226+D, soil density = 1.0 g/cm**3	1.550E+01	1.550E+01	DCF1(4,1)
A-1	Ra-226+D, soil density = 1.8 g/cm**3	8.540E+00	8.540E+00	DCF1(4,2)
A-1	Ra-228+D, soil density = 1.0 g/cm**3	8.180E+00	8.180E+00	DCF1(5,1)
A-1	Ra-228+D, soil density = 1.8 g/cm**3	4.510E+00	4.510E+00	DCF1(5,2)
A-1	Th-228+D, soil density = 1.0 g/cm**3	1.330E+01	1.330E+01	DCF1(6,1)
A-1	Th-228+D, soil density = 1.8 g/cm**3	7.360E+00	7.360E+00	DCF1(6,2)
A-1	Th-230, soil density = 1.0 g/cm**3	2.110E-03	2.110E-03	DCF1(7,1)
A-1	Th-230, soil density = 1.8 g/cm**3	1.030E-03	1.030E-03	DCF1(7,2)
A-1	Th-232, soil density = 1.0 g/cm**3	1.350E-03	1.350E-03	DCF1(8,1)
A-1	Th-232, soil density = 1.8 g/cm**3	6.040E-04	6.040E-04	DCF1(8,2)
A-1	U-234, soil density = 1.0 g/cm**3	1.580E-03	1.580E-03	DCF1(9,1)
A-1	U-234, soil density = 1.8 g/cm**3	6.970E-04	6.970E-04	DCF1(9,2)
A-1	U-235+D, soil density = 1.0 g/cm**3	8.940E-01	8.940E-01	DCF1(10,1)
A-1	U-235+D, soil density = 1.8 g/cm**3	4.900E-01	4.900E-01	DCF1(10,2)
A-1	U-238+D, soil density = 1.0 g/cm**3	1.270E-01	1.270E-01	DCF1(11,1)
A-1	U-238+D, soil density = 1.8 g/cm**3	6.970E-02	6.970E-02	DCF1(11,2)
A-3	Depth factors, ground external gamma, dimensionless:			
A-3	Ac-227+D, soil density = 1.0 g/cm**3, thickness = .15 m	7.900E-01	7.900E-01	FD(1,1,1)
A-3	Ac-227+D, soil density = 1.0 g/cm**3, thickness = 0.5 m	9.700E-01	9.700E-01	FD(1,2,1)
A-3	Ac-227+D, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(1,3,1)
A-3	Ac-227+D, soil density = 1.8 g/cm**3, thickness = .15 m	9.100E-01	9.100E-01	FD(1,1,2)
A-3	Ac-227+D, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(1,2,2)
A-3	Ac-227+D, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(1,3,2)
A-3	Pu-231, soil density = 1.0 g/cm**3, thickness = .15 m	7.900E-01	7.900E-01	FD(2,1,1)
A-3	Pu-231, soil density = 1.0 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(2,2,1)
A-3	Pu-231, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(2,3,1)
A-3	Pu-231, soil density = 1.8 g/cm**3, thickness = .15 m	9.200E-01	9.200E-01	FD(2,1,2)
A-3	Pu-231, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(2,2,2)
A-3	Pu-231, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(2,3,2)

Dose Conversion Factor (and related) Parameter Summary (continued)
File: DOSFAC.BIM

Menu	Parameter	Current Value	Default	Parameter Name
A-3	Pb-210+D, soil density = 1.0 g/cm**3, thickness = .15 m	8.800E-01	8.800E-01	FD(3,1,1)
A-3	Pb-210+D, soil density = 1.0 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(3,2,1)
A-3	Pb-210+D, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(3,3,1)
A-3	Pb-210+D, soil density = 1.8 g/cm**3, thickness = .15 m	9.700E-01	9.700E-01	FD(3,1,2)
A-3	Pb-210+D, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(3,2,2)
A-3	Pb-210+D, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(3,3,2)
A-3				
A-3	Ra-226+D, soil density = 1.0 g/cm**3, thickness = .15 m	6.300E-01	6.300E-01	FD(4,1,1)
A-3	Ra-226+D, soil density = 1.0 g/cm**3, thickness = 0.5 m	9.200E-01	9.200E-01	FD(4,2,1)
A-3	Ra-226+D, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(4,3,1)
A-3	Ra-226+D, soil density = 1.8 g/cm**3, thickness = .15 m	8.500E-01	8.500E-01	FD(4,1,2)
A-3	Ra-226+D, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(4,2,2)
A-3	Ra-226+D, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(4,3,2)
A-3				
A-3	Ra-228+D, soil density = 1.0 g/cm**3, thickness = .15 m	6.800E-01	6.800E-01	FD(5,1,1)
A-3	Ra-228+D, soil density = 1.0 g/cm**3, thickness = 0.5 m	9.700E-01	9.700E-01	FD(5,2,1)
A-3	Ra-228+D, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(5,3,1)
A-3	Ra-228+D, soil density = 1.8 g/cm**3, thickness = .15 m	8.500E-01	8.500E-01	FD(5,1,2)
A-3	Ra-228+D, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(5,2,2)
A-3	Ra-228+D, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(5,3,2)
A-3				
A-3	Th-228+D, soil density = 1.0 g/cm**3, thickness = .15 m	6.100E-01	6.100E-01	FD(6,1,1)
A-3	Th-228+D, soil density = 1.0 g/cm**3, thickness = 0.5 m	9.400E-01	9.400E-01	FD(6,2,1)
A-3	Th-228+D, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(6,3,1)
A-3	Th-228+D, soil density = 1.8 g/cm**3, thickness = .15 m	7.500E-01	7.500E-01	FD(6,1,2)
A-3	Th-228+D, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(6,2,2)
A-3	Th-228+D, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(6,3,2)
A-3				
A-3	Th-230, soil density = 1.0 g/cm**3, thickness = .15 m	9.300E-01	9.300E-01	FD(7,1,1)
A-3	Th-230, soil density = 1.0 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(7,2,1)
A-3	Th-230, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(7,3,1)
A-3	Th-230, soil density = 1.8 g/cm**3, thickness = .15 m	1.000E+00	1.000E+00	FD(7,1,2)
A-3	Th-230, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(7,2,2)
A-3	Th-230, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(7,3,2)
A-3				
A-3	Th-232, soil density = 1.0 g/cm**3, thickness = .15 m	9.500E-01	9.500E-01	FD(8,1,1)
A-3	Th-232, soil density = 1.0 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(8,2,1)
A-3	Th-232, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(8,3,1)
A-3	Th-232, soil density = 1.8 g/cm**3, thickness = .15 m	1.000E+00	1.000E+00	FD(8,1,2)
A-3	Th-232, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(8,2,2)
A-3	Th-232, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(8,3,2)
A-3				
A-3	U-234, soil density = 1.0 g/cm**3, thickness = .15 m	9.000E-01	9.000E-01	FD(9,1,1)
A-3	U-234, soil density = 1.0 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(9,2,1)
A-3	U-234, soil density = 1.0 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(9,3,1)
A-3	U-234, soil density = 1.8 g/cm**3, thickness = .15 m	1.000E+00	1.000E+00	FD(9,1,2)
A-3	U-234, soil density = 1.8 g/cm**3, thickness = 0.5 m	1.000E+00	1.000E+00	FD(9,2,2)
A-3	U-234, soil density = 1.8 g/cm**3, thickness = 1.0 m	1.000E+00	1.000E+00	FD(9,3,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
A-3	U-235+D, soil density = 1.0 g/cm ³ , thickness = .15 m	8.700E-01	8.700E-01	FD(10,1,1)
A-3	U-235+D, soil density = 1.0 g/cm ³ , thickness = 0.5 m	1.000E+00	1.000E+00	FD(10,2,1)
A-3	U-235+D, soil density = 1.0 g/cm ³ , thickness = 1.0 m	1.000E+00	1.000E+00	FD(10,3,1)
A-3	U-235+D, soil density = 1.8 g/cm ³ , thickness = .15 m	1.000E+00	1.000E+00	FD(10,1,2)
A-3	U-235+D, soil density = 1.8 g/cm ³ , thickness = 0.5 m	1.000E+00	1.000E+00	FD(10,2,2)
A-3	U-235+D, soil density = 1.8 g/cm ³ , thickness = 1.0 m	1.000E+00	1.000E+00	FD(10,3,2)
A-3	U-238+D, soil density = 1.0 g/cm ³ , thickness = .15 m	7.800E-01	7.800E-01	FD(11,1,1)
A-3	U-238+D, soil density = 1.0 g/cm ³ , thickness = 0.5 m	1.000E+00	1.000E+00	FD(11,2,1)
A-3	U-238+D, soil density = 1.0 g/cm ³ , thickness = 1.0 m	1.000E+00	1.000E+00	FD(11,3,1)
A-3	U-238+D, soil density = 1.8 g/cm ³ , thickness = .15 m	8.800E-01	8.800E-01	FD(11,1,2)
A-3	U-238+D, soil density = 1.8 g/cm ³ , thickness = 0.5 m	1.000E+00	1.000E+00	FD(11,2,2)
A-3	U-238+D, soil density = 1.8 g/cm ³ , thickness = 1.0 m	1.000E+00	1.000E+00	FD(11,3,2)
B-1	Dose conversion factors for inhalation, arem/pCi:			
B-1	Ac-227+D			
B-1	Po-210	6.700E+00	6.700E+00	DCF2(1)
B-1	Pb-210+D	1.300E+00	1.300E+00	DCF2(2)
B-1	Ra-226+D	2.100E-02	2.100E-02	DCF2(3)
B-1	Ra-228+D	7.900E-03	7.900E-03	DCF2(4)
B-1	Th-228+D	4.500E-03	4.500E-03	DCF2(5)
B-1	Th-230	3.100E-01	3.100E-01	DCF2(6)
B-1	Th-232	3.200E-01	3.200E-01	DCF2(7)
B-1	U-234	1.600E+00	1.600E+00	DCF2(8)
B-1	U-235+D	1.300E-01	1.300E-01	DCF2(9)
B-1	U-238+D	1.200E-01	1.200E-01	DCF2(10)
		1.200E-01	1.200E-01	DCF2(11)
D-1	Dose conversion factors for ingestion, arem/pCi:			
D-1	Ac-227+D			
D-1	Po-210	1.500E-02	1.500E-02	DCF3(1)
D-1	Pb-210+D	1.100E-02	1.100E-02	DCF3(2)
D-1	Ra-226+D	6.700E-03	6.700E-03	DCF3(3)
D-1	Ra-228+D	1.100E-03	1.100E-03	DCF3(4)
D-1	Th-228+D	1.200E-03	1.200E-03	DCF3(5)
D-1	Th-230	7.500E-04	7.500E-04	DCF3(6)
D-1	Th-232	5.300E-04	5.300E-04	DCF3(7)
D-1	U-234	2.800E-03	2.800E-03	DCF3(8)
D-1	U-235+D	2.600E-04	2.600E-04	DCF3(9)
D-1	U-238+D	2.500E-04	2.500E-04	DCF3(10)
		2.500E-04	2.500E-04	DCF3(11)
D-34	Food transfer factors:			
D-34	Ac-227+D, plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Po-210, plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Po-210, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Po-210, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Pb-210-D, plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210-D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210-D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34	Ra-226-D, plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226-D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226-D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34	Ra-228-D, plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228-D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228-D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34	Th-228-D, plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228-D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228-D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34	Th-230, plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34	Th-232, plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-232, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-232, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34	U-234, plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34	U-235-D, plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-235-D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-235-D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34	U-238-D, plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238-D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238-D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227-D, fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227-D, crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Pa-231, fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231, crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5	Pb-210-D, fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210-D, crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5	Ra-226-D, fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226-D, crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5	Ra-228-D, fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228-D, crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DCFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
RD11	Area of contaminated zone (m**2)	1.000E+03	1.000E+04	---	AREA
RD11	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICKD
RD11	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LC2PAQ
RD11	Basic radiation dose limit (mrem/yr)	5.000E+02	3.000E+01	---	BRDL
RD11	Time since placement of material (yr)	0.000E+00	0.000E+00	---	T1
RD11	Times for calculations (yr)	1.000E+01	1.000E+00	---	T(2)
RD11	Times for calculations (yr)	3.000E+01	3.000E+00	---	T(3)
RD11	Times for calculations (yr)	7.000E+01	1.000E+01	---	T(4)
RD11	Times for calculations (yr)	1.000E+02	3.000E+01	---	T(5)
RD11	Times for calculations (yr)	2.000E+02	1.000E+02	---	T(6)
RD11	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
RD11	Times for calculations (yr)	5.000E+02	1.000E+03	---	T(8)
RD11	Times for calculations (yr)	7.500E+02	3.000E+03	---	T(9)
RD11	Times for calculations (yr)	1.000E+03	1.000E+04	---	T(10)
RD12	Initial principal radionuclide (pCi/g): Pa-231	1.000E+00	0.000E+00	---	S1(2)
RD12	Initial principal radionuclide (pCi/g): Ra-226	1.000E+00	0.000E+00	---	S1(4)
RD12	Initial principal radionuclide (pCi/g): Th-228	1.000E+00	0.000E+00	---	S1(6)
RD12	Initial principal radionuclide (pCi/g): Th-230	1.000E+00	0.000E+00	---	S1(7)
RD12	Initial principal radionuclide (pCi/g): Th-232	1.000E+00	0.000E+00	---	S1(8)
RD12	Initial principal radionuclide (pCi/g): U-234	1.000E+00	0.000E+00	---	S1(9)
RD12	Initial principal radionuclide (pCi/g): U-235	1.000E+00	0.000E+00	---	S1(10)
RD12	Initial principal radionuclide (pCi/g): U-238	1.000E+00	0.000E+00	---	S1(11)
RD12	Concentration in groundwater (pCi/L): Pa-231	not used	0.000E+00	---	W1(2)
RD12	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
RD12	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(6)
RD12	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
RD12	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(8)
RD12	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(9)
RD12	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(10)
RD12	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(11)
RD13	Cover depth (m)	0.000E+00	0.000E+00	---	COVERD
RD13	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
RD13	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
RD13	Density of contaminated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSCZ
RD13	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
RD13	Contaminated zone total porosity	4.000E-01	6.000E-01	---	TPCZ
RD13	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCE
RD13	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
RD13	Humidity in air (g/cm**3)	5.300E+00	5.300E+00	---	BCZ
RD13	Evapotranspiration coefficient	not used	6.000E+00	---	HUMCD
RD13	Precipitation (m/yr)	5.000E-01	3.000E-01	---	EVAPTR
RD13	Irrigation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
RD13	Irrigation mode	2.000E-01	2.000E-01	---	RI
RD13	Runoff coefficient	overhead	overhead	---	IDITCH
RD13	Watershed area for nearby stream or pond (m**2)	2.000E-01	2.000E-01	---	RUMOFF
RD13	Accuracy for water/soil computations	1.000E+06	1.000E+06	---	WAREA
RD13		1.000E-03	1.000E-03	---	EPS
RD14	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGMT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIMT
R014	Model: Mondispersion (MD) or Mass-Balance (MB)	MD	MD	---	MODEL
R014	Well pumping rate (m ³ /yr)	2.500E+02	2.500E+02	---	WQ
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	1.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm ³)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Fe-231				
R016	Contaminated zone (cm ³ /g)	5.500E+02	5.000E+01	---	DCNUCC(2)
R016	Unsat. zone 1 (cm ³ /g)	5.500E+02	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm ³ /g)	5.500E+02	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.272E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm ³ /g)	5.000E+02	7.000E+01	---	DCNUCC(4)
R016	Unsat. zone 1 (cm ³ /g)	5.000E+02	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm ³ /g)	5.000E+02	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.495E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCC(6)
R016	Unsat. zone 1 (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.906E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCC(7)
R016	Unsat. zone 1 (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.906E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCC(8)
R016	Unsat. zone 1 (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm ³ /g)	3.200E+03	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.906E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
RD16	Distribution coefficients for U-234				
RD16	Contaminated zone (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (9)
RD16	Unsaturated zone 1 (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (9,1)
RD16	Saturated zone (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (9)
RD16	Leach rate (/yr)	0.000E+00	0.000E+00	3.555E-03	ALRACH (9)
RD16	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK (9)
RD16	Distribution coefficients for U-235				
RD16	Contaminated zone (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (10)
RD16	Unsaturated zone 1 (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (10,1)
RD16	Saturated zone (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (10)
RD16	Leach rate (/yr)	0.000E+00	0.000E+00	3.555E-03	ALRACH (10)
RD16	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK (10)
RD16	Distribution coefficients for U-238				
RD16	Contaminated zone (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (11)
RD16	Unsaturated zone 1 (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (11,1)
RD16	Saturated zone (cm**3/g)	3.500E+01	5.000E+01	---	DCMUCC (11)
RD16	Leach rate (/yr)	0.000E+00	0.000E+00	3.555E-03	ALRACH (11)
RD16	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK (11)
RD16	Distribution coefficients for daughter Ac-227				
RD16	Contaminated zone (cm**3/g)	4.500E+02	2.000E+01	---	DCMUCC (1)
RD16	Unsaturated zone 1 (cm**3/g)	4.500E+02	2.000E+01	---	DCMUCC (1,1)
RD16	Saturated zone (cm**3/g)	4.500E+02	2.000E+01	---	DCMUCC (1)
RD16	Leach rate (/yr)	0.000E+00	0.000E+00	2.777E-04	ALRACH (1)
RD16	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK (1)
RD16	Distribution coefficients for daughter Pb-210				
RD16	Contaminated zone (cm**3/g)	2.700E+02	1.000E+02	---	DCMUCC (3)
RD16	Unsaturated zone 1 (cm**3/g)	2.700E+02	1.000E+02	---	DCMUCC (3,1)
RD16	Saturated zone (cm**3/g)	2.700E+02	1.000E+02	---	DCMUCC (3)
RD16	Leach rate (/yr)	0.000E+00	0.000E+00	4.627E-04	ALRACH (3)
RD16	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK (3)
RD16	Distribution coefficients for daughter Ra-226				
RD16	Contaminated zone (cm**3/g)	5.000E+02	7.000E+01	---	DCMUCC (5)
RD16	Unsaturated zone 1 (cm**3/g)	5.000E+02	7.000E+01	---	DCMUCC (5,1)
RD16	Saturated zone (cm**3/g)	5.000E+02	7.000E+01	---	DCMUCC (5)
RD16	Leach rate (/yr)	0.000E+00	0.000E+00	2.499E-04	ALRACH (5)
RD16	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK (5)
RD17	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
RD17	Mass loading for inhalation (g/m**3)	5.500E-05	2.000E-04	---	MLDMH
RD17	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
RD17	Exposure duration	3.000E+01	3.000E+01	---	ED
RD17	Shielding factor, inhalation	5.000E-01	4.000E-01	---	SHF3
RD17	Shielding factor, external gamma	3.300E-01	7.000E-01	---	SHF1
RD17	Fraction of time spent indoors	5.500E-01	5.000E-01	---	FIND
RD17	Fraction of time spent outdoors (on site)	2.000E-01	2.500E-01	---	FOTD
RD17	Shape factor, external gamma	1.000E+00	1.000E+00	---	PF1

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
RD17	Fractions of annular areas within AREA:				
RD17	Outer annular radius (m) = $\sqrt{(1/n)}$	not used	1.000E+00	---	FRACA (1)
RD17	Outer annular radius (m) = $\sqrt{(10/n)}$	not used	1.000E+00	---	FRACA (2)
RD17	Outer annular radius (m) = $\sqrt{(20/n)}$	not used	1.000E+00	---	FRACA (3)
RD17	Outer annular radius (m) = $\sqrt{(50/n)}$	not used	1.000E+00	---	FRACA (4)
RD17	Outer annular radius (m) = $\sqrt{(100/n)}$	not used	1.000E+00	---	FRACA (5)
RD17	Outer annular radius (m) = $\sqrt{(200/n)}$	not used	1.000E+00	---	FRACA (6)
RD17	Outer annular radius (m) = $\sqrt{(500/n)}$	not used	1.000E+00	---	FRACA (7)
RD17	Outer annular radius (m) = $\sqrt{(1000/n)}$	not used	1.000E+00	---	FRACA (8)
RD17	Outer annular radius (m) = $\sqrt{(5000/n)}$	not used	1.000E+00	---	FRACA (9)
RD17	Outer annular radius (m) = $\sqrt{(1.E+04/n)}$	not used	1.000E+00	---	FRACA (10)
RD17	Outer annular radius (m) = $\sqrt{(1.E+05/n)}$	not used	0.000E+00	---	FRACA (11)
RD17	Outer annular radius (m) = $\sqrt{(1.E+06/n)}$	not used	0.000E+00	---	FRACA (12)
RD18	Fruits, vegetables and grains consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET (1)
RD18	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET (2)
RD18	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET (3)
RD18	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET (4)
RD18	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET (5)
RD18	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET (6)
RD18	Foli ingestion rate (g/yr)	3.650E+01	3.650E+01	---	BOIL
RD18	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DMT
RD18	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
RD18	Contamination fraction of household water	1.000E+00	1.000E+00	---	FDHWH
RD18	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
RD18	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FLM
RD18	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FRS
RD18	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
RD18	Contamination fraction of meat	-1	-1	0.500E-01	FMEAT
RD18	Contamination fraction of milk	-1	-1	0.500E-01	FMILK
RD19	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
RD19	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
RD19	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
RD19	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
RD19	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
RD19	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
RD19	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
RD19	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
RD19	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGNDW
RD19	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGHSH
RD19	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGHSH
RD19	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGHSH
CL4	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	CL2WTR
CL4	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	CL2CS
CL4	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
CL4	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
CL4	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
CL4	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSX
CL4	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVPG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVPG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grains	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	1.500E-01	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	WQOCV
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---	WQOFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	3.000E-07	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCS
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	MIXL
R021	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	5.000E-01	5.000E-01	---	RELX
R021	Height of the building (room) (m)	2.500E+00	2.500E+00	---	HOBH
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	1.000E+00	1.000E+00	---	DNFL
R021	Emanating power of Rn-222 gas	1.000E-02	2.500E-01	---	EDGUA(1)
R021	Emanating power of Rn-220 gas	1.000E-02	1.500E-01	---	EDGUA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	active

Contaminated Zone Dimensions

Area:	1000.00 square meters
Thickness:	2.00 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, $\mu\text{Ci/g}$

Pa-231	1.000E+00
Ra-226	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

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Total Dose TD05E(t), mrem/yr

Basic Radiation Dose Limit = 500 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+01	3.000E+01	7.000E+01	1.000E+02	2.000E+02	3.000E+02	5.000E+02	7.500E+02	1.000E+03
TD0SE(t):	2.982E+01	3.594E+01	4.339E+01	4.683E+01	4.776E+01	4.850E+01	4.850E+01	4.795E+01	4.491E+01	4.171E+01
M(t):	5.964E-02	7.188E-02	8.679E-02	9.366E-02	9.533E-02	9.700E-02	9.700E-02	9.589E-02	8.983E-02	8.343E-02
Maximum TD0SE(t):	4.853E+01 mrem/yr	at t =		247.5 ± 0.2 years						

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Total Dose Contributions $\text{DOSE}(i,p,t)$ for Individual Radionuclides (i) and Pathways (p)
As $\mu\text{rem/yr}$ and Fraction of Total Dose At $t = 347.5$ years

Water Independent Pathways (labelation excludes water)

9

9

[illegible]

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As $\mu\text{rem/yr}$ and Fraction of Total Dose At $t = 247.5$ years

As mrem/yr and Fraction of Total Dose At t = 247.5 years and Pathways (p)																
Radio- Nuclide	Water		Fish		Water Dependent Pathways				Plant		Hest		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	7.626E-01	0.0000	1.011E-04	0.0000	1.375E-06	0.0000	5.866E-02	0.0000	2.777E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	7.443E-01	0.0000	1.030E-04	0.0000	0.000E+00	0.0000	5.725E-02	0.0000	2.925E-04	0.0000	0.000E+00	0.0000	1.032E-03	0.0000	0.000E+00	0.0000
U-238	7.343E-01	0.0000	9.718E-05	0.0000	1.067E-08	0.0000	5.648E-02	0.0000	2.673E-04	0.0000	0.000E+00	0.0000	1.032E-03	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
*Sum of	all water independent and dependent pathways.															

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	7.488E-02	0.0025	2.606E-01	0.0087	0.000E+00	0.0000	9.576E+00	0.3212	2.047E-01	0.0069	2.660E-04	0.0000	1.907E-01	0.004
Ra-226	3.309E+00	0.1780	1.583E-03	0.0001	4.275E+00	0.1434	3.829E+00	0.1284	1.116E-02	0.0004	1.367E-02	0.0005	1.907E-02	0.000
Th-228	4.567E+00	0.1532	6.213E-02	0.0021	8.724E-03	0.0003	6.484E-02	0.0022	1.313E-04	0.0000	9.547E-06	0.0000	1.300E-02	0.000
Th-230	6.194E-04	0.0000	6.414E-02	0.0022	0.000E+00	0.0000	4.641E-02	0.0016	9.312E-05	0.0000	6.783E-06	0.0000	9.189E-03	0.000
Th-232	3.554E-04	0.0000	3.207E-01	0.0108	0.000E+00	0.0000	2.452E-01	0.0082	5.025E-04	0.0000	3.583E-05	0.0000	4.855E-02	0.001
U-234	4.086E-04	0.0000	2.606E-02	0.0009	0.000E+00	0.0000	5.670E-02	0.0019	1.871E-04	0.0000	4.585E-04	0.0000	4.508E-03	0.000
U-235	3.033E-01	0.0102	2.405E-02	0.0008	0.000E+00	0.0000	5.452E-02	0.0018	1.799E-04	0.0000	4.409E-04	0.0000	4.334E-03	0.000
U-238	4.316E-02	0.0014	2.405E-02	0.0008	0.000E+00	0.0000	5.452E-02	0.0018	1.799E-04	0.0000	4.409E-04	0.0000	4.334E-03	0.000
Total	1.030E+01	0.3454	7.833E-01	0.0263	4.283E+00	0.1436	1.393E+01	0.4671	2.172E-01	0.0073	1.533E-02	0.0005	2.937E-01	0.009

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.031E+01	0.345
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.346E+01	0.451
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.716E+00	0.158
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.205E-01	0.004
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.153E-01	0.020
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.832E-02	0.003
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.868E-01	0.013
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.267E-01	0.004
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.982E+01	1.000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radionuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	3.313E-01	0.0092	6.257E-01	0.0174	0.000E+00	0.0000	1.046E+01	0.2910	2.049E-01	0.0037	5.083E-04	0.0000	2.611E-01	0.0073
Ra-226	5.273E+00	0.1467	2.691E-03	0.0001	4.245E+00	0.1181	5.376E+00	0.1496	1.663E-02	0.0005	1.624E-02	0.0005	4.980E-02	0.0014
Th-228	1.219E-01	0.0034	1.658E-03	0.0000	2.328E-04	0.0000	1.730E-03	0.0000	3.503E-06	0.0000	2.548E-07	0.0000	3.470E-04	0.0000
Th-230	2.353E-02	0.0007	6.412E-03	0.0018	1.845E-02	0.0005	6.656E-02	0.0019	1.566E-04	0.0000	7.204E-05	0.0000	9.337E-03	0.0003
Th-232	4.526E+00	0.1259	3.563E-01	0.0099	4.913E-03	0.0001	3.212E+00	0.0894	9.055E-03	0.0003	1.035E-02	0.0003	7.039E-02	0.0020
U-234	3.954E-04	0.0000	2.515E-02	0.0007	8.217E-07	0.0000	5.472E-02	0.0015	1.805E-04	0.0000	4.425E-04	0.0000	4.351E-03	0.0001
U-235	2.928E-01	0.0081	2.331E-02	0.0006	0.000E+00	0.0000	3.470E-02	0.0015	2.162E-04	0.0000	4.256E-04	0.0000	4.230E-03	0.0001
U-238	4.165E-02	0.0012	2.321E-02	0.0006	7.706E-12	0.0000	5.261E-02	0.0015	1.736E-04	0.0000	4.255E-04	0.0000	4.183E-03	0.0001
Total	1.061E+01	0.2952	1.122E+00	0.0312	4.269E+00	0.1188	1.928E+01	0.5363	2.313E-01	0.0064	2.846E-02	0.0008	4.037E-01	0.0112

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radionuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.188E+01	0.3306
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.498E+01	0.4168
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.258E-01	0.0035
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.822E-01	0.0051
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.190E+00	0.2279
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.524E-02	0.0024
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.756E-01	0.0105
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.223E-01	0.0034
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.594E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDCE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Fe-231	6.500E-01	0.0150	1.079E+00	0.0249	0.000E+00	0.0000	1.152E+01	0.2654	2.041E-01	0.0047	8.053E-04	0.0000	3.482E-01	0.0001
Re-226	3.202E+00	0.1199	4.059E-03	0.0001	4.188E+00	0.0965	7.247E+00	0.1670	2.306E-02	0.0005	1.925E-02	0.0004	8.789E-02	0.0001
Th-228	8.680E-03	0.0003	1.181E-06	0.0000	1.658E-07	0.0000	1.232E-06	0.0000	2.495E-09	0.0000	1.815E-10	0.0000	2.472E-07	0.0000
Th-230	6.897E-02	0.0016	6.409E-03	0.0015	5.495E-02	0.0013	1.221E-01	0.0028	3.315E-04	0.0000	2.272E-04	0.0000	9.942E-03	0.0000
Th-232	7.083E+00	0.1622	3.807E-01	0.0088	8.348E-03	0.0002	4.375E+00	0.1008	1.240E-02	0.0003	1.435E-02	0.0003	8.112E-02	0.0001
U-234	3.764E-04	0.0000	2.344E-02	0.0005	7.189E-06	0.0000	5.098E-02	0.0012	1.682E-04	0.0000	4.121E-04	0.0000	4.054E-03	0.0000
U-235	2.729E-01	0.0063	2.207E-02	0.0005	0.000E+00	0.0000	5.346E-02	0.0013	2.848E-04	0.0000	3.966E-04	0.0000	4.064E-03	0.0000
U-238	3.879E-02	0.0009	2.162E-02	0.0005	2.001E-10	0.0000	4.901E-02	0.0011	1.617E-04	0.0000	3.963E-04	0.0000	3.796E-03	0.0000
Total	1.332E+01	0.3049	1.595E+00	0.0368	4.251E+00	0.0980	2.342E+01	0.5396	2.405E-01	0.0055	3.584E-02	0.0008	5.392E-01	0.012

Total Dose Contributions TDCE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Fe-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.380E+01	0.3180
Re-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.677E+01	0.3865
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.963E-05	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.205E-01	0.0074
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.195E+01	0.2755
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.943E-02	0.0018
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.551E-01	0.0082
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.139E-01	0.0026
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.339E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	8.995E-01	0.0192	1.434E+00	0.0306	0.000E+00	0.0000	1.229E+01	0.2624	2.023E-01	0.0043	1.037E-03	0.0000	4.154E-01	0.008
Am-226	5.062E+00	0.1061	5.065E-03	0.0001	4.075E+00	0.0670	8.423E+00	0.1841	2.780E-02	0.0006	2.135E-02	0.0005	1.169E-01	0.002
Th-228	4.403E-11	0.0000	5.991E-13	0.0000	8.412E-14	0.0000	6.252E-13	0.0000	1.266E-15	0.0000	9.205E-17	0.0000	1.254E-13	0.000
Th-230	1.576E-01	0.0034	6.404E-02	0.0014	1.264E-01	0.0027	2.621E-01	0.0056	7.810E-04	0.0000	5.830E-04	0.0000	1.175E-02	0.000
Th-232	7.328E+00	0.1565	3.826E-01	0.0082	6.682E-02	0.0002	4.482E+00	0.0957	1.270E-02	0.0003	1.472E-02	0.0003	8.206E-02	0.001
U-234	3.649E-04	0.0000	2.035E-02	0.0004	3.700E-03	0.0000	4.428E-02	0.0009	1.461E-04	0.0000	3.576E-04	0.0000	3.520E-03	0.000
U-235	2.373E-01	0.0051	2.016E-02	0.0004	0.000E+00	0.0000	5.756E-02	0.0012	4.072E-04	0.0000	3.448E-04	0.0000	3.835E-03	0.000
U-238	3.365E-02	0.0007	1.876E-02	0.0004	2.353E-09	0.0000	4.251E-02	0.0009	1.403E-04	0.0000	3.438E-04	0.0000	3.380E-03	0.000
Total	1.372E+01	0.2929	1.944E+00	0.0415	4.210E+00	0.0699	2.580E+01	0.5510	2.442E-01	0.0052	3.874E-02	0.0008	6.368E-01	0.0136

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+01 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.524E+01	0.3255
Am-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.793E+01	0.3829
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.547E+11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.232E-01	0.0133
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.231E+01	0.2629
U-234	7.508E-02	0.0016	9.837E-06	0.0000	8.258E-10	0.0000	5.775E-03	0.0001	2.733E-05	0.0000	1.055E-04	0.0000	1.501E-01	0.0032
U-235	7.225E-02	0.0015	9.571E-06	0.0000	0.000E+00	0.0000	5.557E-03	0.0001	2.643E-05	0.0000	1.015E-04	0.0000	3.976E-01	0.0085
U-238	7.222E-02	0.0015	9.559E-06	0.0000	3.580E-11	0.0000	5.555E-03	0.0001	2.629E-05	0.0000	1.015E-04	0.0000	1.767E-01	0.0038
Total	2.195E-01	0.0047	2.907E-05	0.0000	9.216E-10	0.0000	1.689E-02	0.0004	8.008E-05	0.0000	3.086E-04	0.0000	4.683E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	9.334E-01	0.0200	1.509E+00	0.0316	0.000E+00	0.0000	1.241E+01	0.2598	2.008E-01	0.0042	1.086E-03	0.0000	4.291E-01	0.005
Ra-226	4.959E+00	0.1038	5.257E-03	0.0001	3.992E+00	0.0836	8.830E+00	0.1849	2.854E-02	0.0006	2.155E-02	0.0005	1.221E-01	0.002
Th-228	8.370E-16	0.0000	1.139E-17	0.0000	1.599E-18	0.0000	1.188E-17	0.0000	2.406E-20	0.0000	1.730E-21	0.0000	2.383E-18	0.000
Th-230	2.224E-01	0.0047	6.402E-02	0.0013	1.786E-01	0.0037	3.754E-01	0.0079	1.147E-03	0.0000	8.614E-04	0.0000	1.330E-02	0.000
Th-232	7.321E+00	0.1533	3.821E-01	0.0080	8.675E-03	0.0002	4.478E+00	0.0937	1.269E-02	0.0003	1.471E-02	0.0003	8.197E-02	0.001
U-234	3.768E-04	0.0000	1.830E-02	0.0004	7.245E-05	0.0000	3.988E-02	0.0008	1.315E-04	0.0000	3.216E-04	0.0000	3.167E-03	0.000
U-235	2.139E-01	0.0045	1.901E-02	0.0004	0.000E+00	0.0000	5.918E-02	0.0012	4.872E-04	0.0000	3.106E-04	0.0000	3.702E-03	0.000
U-238	3.025E-02	0.0006	1.686E-02	0.0004	6.477E-09	0.0000	3.822E-02	0.0008	1.261E-04	0.0000	3.091E-04	0.0000	3.038E-03	0.000
Total	1.370E+01	0.2868	2.015E+00	0.0423	4.180E+00	0.0875	2.423E+01	0.5491	2.439E-01	0.0051	3.915E-02	0.0008	6.563E-01	0.013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.550E+01	0.3246
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.796E+01	0.3760
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.643E-16	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.557E-01	0.2179
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.230E+01	0.2575
U-234	2.220E-01	0.0046	2.938E-05	0.0000	2.217E-06	0.0000	1.707E-02	0.0004	8.081E-05	0.0000	3.120E-04	0.0000	3.017E-01	0.0063
U-235	2.140E-01	0.0045	2.852E-05	0.0000	0.000E+00	0.0000	1.646E-02	0.0003	7.929E-05	0.0000	3.001E-04	0.0000	5.274E-01	0.0110
U-238	2.136E-01	0.0045	2.826E-05	0.0000	5.068E-10	0.0000	1.643E-02	0.0003	7.774E-05	0.0000	3.002E-04	0.0000	3.192E-01	0.0067
Total	4.495E-01	0.0136	8.616E-05	0.0000	2.268E-06	0.0000	4.996E-02	0.0010	2.378E-04	0.0000	9.124E-04	0.0000	4.776E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	9.653E-01	0.0199	3.522E+00	0.0314	0.000E+00	0.0000	1.223E+01	0.2521	1.959E-01	0.0040	1.092E-03	0.0000	4.283E-01	0.0088
Ra-226	4.632E+00	0.0955	5.071E-03	0.0001	3.729E+00	0.0769	8.470E+00	0.1746	2.742E-02	0.0006	2.050E-02	0.0004	1.185E-01	0.0024
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	4.285E-01	0.0088	6.394E-02	0.0013	3.445E-01	0.0071	7.497E-01	0.0155	2.358E-03	0.0000	1.770E-03	0.0000	1.848E-02	0.0004
U-234	5.161E-04	0.0000	1.267E-02	0.0003	2.533E-04	0.0000	2.838E-02	0.0006	9.330E-05	0.0000	1.465E-02	0.0003	8.165E-02	0.0017
U-235	1.516E-01	0.0031	1.604E-02	0.0003	0.000E+00	0.0000	6.342E-02	0.0013	6.941E-04	0.0000	2.196E-04	0.0000	2.360E-03	0.0001
U-238	2.120E-02	0.0004	1.182E-02	0.0002	4.292E-08	0.0000	2.679E-02	0.0006	8.839E-05	0.0000	2.167E-04	0.0000	2.130E-03	0.0000
Total	1.349E+01	0.2782	2.013E+00	0.0415	4.082E+00	0.0842	2.603E+01	0.5366	2.392E-01	0.0049	3.867E-02	0.0008	6.546E-01	0.0135

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.534E+01	0.3163
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.700E+01	0.3506
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.609E+00	0.0332
U-234	6.169E-01	0.0127	8.172E-05	0.0000	7.001E-07	0.0000	4.745E-02	0.0010	2.246E-04	0.0000	0.000E+00	0.0000	1.225E+01	0.2526
U-235	5.994E-01	0.0124	8.286E-05	0.0000	0.000E+00	0.0000	4.611E-02	0.0010	2.311E-04	0.0000	8.672E-04	0.0000	7.101E-01	0.0146
U-238	5.938E-01	0.0122	7.860E-05	0.0000	5.703E-09	0.0000	4.568E-02	0.0009	2.162E-04	0.0000	8.345E-04	0.0000	8.820E-01	0.0182
Total	1.810E+00	0.0373	2.432E-04	0.0000	7.058E-07	0.0000	1.392E-01	0.0029	6.719E-04	0.0000	2.537E-03	0.0001	4.850E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-231	9.430E-01	0.0194	1.487E+00	0.0307	0.000E+00	0.0000	1.193E+01	0.2460	1.911E-01	0.0039	1.067E-03	0.0000	4.182E-01	0.0086
Pu-238	4.326E+00	0.0892	4.743E-03	0.0001	3.482E+00	0.0718	7.920E+00	0.1633	2.364E-02	0.0005	1.914E-02	0.0004	1.108E-01	0.0023
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	6.200E-01	0.0128	6.384E-02	0.0013	4.966E-01	0.0103	1.100E+00	0.0227	3.493E-03	0.0001	2.618E-03	0.0001	2.334E-02	0.0005
Th-232	7.264E+00	0.1498	3.792E-01	0.0078	8.607E-03	0.0002	4.443E+00	0.0916	1.259E-02	0.0003	1.459E-02	0.0003	8.134E-02	0.0017
U-234	7.638E-04	0.0000	9.067E-03	0.0002	3.010E-04	0.0000	2.059E-02	0.0004	6.775E-05	0.0000	1.602E-04	0.0000	1.579E-03	0.0000
U-235	1.080E-01	0.0022	1.392E-02	0.0003	0.000E+00	0.0000	6.591E-02	0.0014	8.304E-04	0.0000	1.558E-04	0.0000	3.107E-03	0.0001
U-238	1.486E-02	0.0003	8.286E-03	0.0002	1.206E-07	0.0000	1.878E-02	0.0004	6.197E-05	0.0000	1.519E-04	0.0000	1.493E-03	0.0000
Total	1.328E+01	0.2738	1.966E+00	0.0405	3.990E+00	0.0823	2.550E+01	0.5258	2.338E-01	0.0048	3.791E-02	0.0008	6.399E-01	0.0132

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.497E+01	0.3087
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.589E+01	0.3276
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.312E+00	0.0477
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.220E+01	0.2516
U-234	8.988E-01	0.0185	1.193E-04	0.0000	3.111E-04	0.0000	6.914E-02	0.0014	3.273E-04	0.0000	1.263E-03	0.0000	1.002E+00	0.0207
U-235	8.817E-01	0.0182	1.274E-04	0.0000	0.000E+00	0.0000	6.782E-02	0.0014	3.539E-04	0.0000	1.216E-03	0.0000	1.143E+00	0.0236
U-238	8.656E-01	0.0178	1.146E-04	0.0000	1.823E-08	0.0000	6.658E-02	0.0014	3.151E-04	0.0000	1.217E-03	0.0000	9.775E-01	0.0202
Total	2.646E+00	0.0546	3.612E-04	0.0000	3.129E-04	0.0000	2.035E-01	0.0042	9.963E-04	0.0000	3.697E-03	0.0001	4.850E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Fe-231	8.974E-01	0.0187	1.413E+00	0.0295	0.000E+00	0.0000	1.135E+01	0.2368	1.818E-01	0.0038	1.015E-03	0.0000	3.979E-01	0.0063
Ra-226	3.774E+00	0.0787	4.138E-03	0.0001	3.038E+00	0.0634	6.909E+00	0.1441	2.236E-02	0.0005	1.672E-02	0.0003	9.669E-02	0.0020
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	9.626E-01	0.0201	6.361E-02	0.0013	7.745E-01	0.0162	1.728E+00	0.0360	9.526E-03	0.0001	4.138E-03	0.0001	3.205E-02	0.0007
Th-232	7.208E+00	0.1503	3.762E-01	0.0078	8.541E-03	0.0002	4.408E+00	0.0919	1.249E-02	0.0003	1.448E-02	0.0003	8.070E-02	0.0017
U-234	1.426E-03	0.0000	4.533E-03	0.0001	1.091E-03	0.0000	1.199E-02	0.0002	3.925E-05	0.0000	8.315E-05	0.0000	8.115E-04	0.0000
U-235	5.579E-02	0.0012	1.121E-02	0.0002	0.000E+00	0.0000	6.748E-02	0.0014	9.702E-04	0.0000	7.966E-05	0.0000	2.757E-03	0.0001
U-238	7.296E-03	0.0002	4.072E-03	0.0001	3.932E-07	0.0000	9.230E-03	0.0002	3.045E-05	0.0000	7.464E-05	0.0000	7.338E-04	0.0000
Total	1.291E+01	0.2692	1.879E+00	0.0392	3.822E+00	0.0797	2.449E+01	0.5107	2.233E-01	0.0047	3.659E-02	0.0008	6.117E-01	0.0128

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Fe-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.425E+01	0.2972
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.386E+01	0.2891
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.570E+00	0.0745
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.211E+01	0.2525
U-234	1.244E+00	0.0259	1.661E-04	0.0000	1.584E-05	0.0000	9.568E-02	0.0020	4.332E-04	0.0000	1.748E-03	0.0000	1.362E+00	0.0284
U-235	1.246E+00	0.0260	1.976E-04	0.0000	0.000E+00	0.0000	9.587E-02	0.0020	5.431E-04	0.0000	1.684E-03	0.0000	1.483E+00	0.0309
U-238	1.199E+00	0.0250	1.587E-04	0.0000	8.274E-08	0.0000	9.221E-02	0.0019	4.364E-04	0.0000	1.685E-03	0.0000	1.315E+00	0.0274
Total	3.689E+00	0.0769	5.223E-04	0.0000	1.593E-05	0.0000	2.838E-01	0.0059	1.433E-03	0.0000	5.118E-03	0.0001	4.795E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOST(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.500E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	6.433E-01	0.0188	1.330E+00	0.0296	0.000E+00	0.0000	1.067E+01	0.2376	1.709E-01	0.0038	9.538E-04	0.0000	3.740E-01	0.0083
Ra-226	3.181E+00	0.0708	3.488E-03	0.0001	2.561E+00	0.0570	5.824E+00	0.1297	1.885E-02	0.0004	1.409E-02	0.0003	8.151E-02	0.0018
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.325E+00	0.0295	6.326E-02	0.0014	1.066E+00	0.0237	2.391E+00	0.0532	7.673E-03	0.0002	5.742E-03	0.0001	4.124E-02	0.0009
Th-232	7.138E+00	0.1589	3.725E-01	0.0083	8.458E-03	0.0002	4.365E+00	0.0972	1.237E-02	0.0003	1.434E-02	0.0003	7.892E-02	0.0018
U-234	2.338E-03	0.0001	1.957E-03	0.0000	1.858E-03	0.0000	8.082E-03	0.0002	2.623E-05	0.0000	4.173E-05	0.0000	3.832E-04	0.0000
U-235	2.597E-02	0.0006	9.391E-03	0.0002	0.000E+00	0.0000	6.610E-02	0.0015	1.013E-03	0.0000	3.618E-05	0.0000	2.478E-03	0.0001
U-238	3.001E-03	0.0001	1.676E-03	0.0000	8.801E-07	0.0000	3.800E-03	0.0001	1.254E-05	0.0000	3.072E-05	0.0000	3.020E-04	0.0000
Total	1.252E+01	0.2787	1.782E+00	0.0397	3.637E+00	0.0810	2.333E+01	0.5184	2.108E-01	0.0047	3.523E-02	0.0008	5.798E-01	0.0129

Total Dose Contributions TDOST(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.500E+02 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.339E+01	0.2981
Ra-226	3.232E-11	0.0000	6.769E-14	0.0000	0.000E+00	0.0000	2.497E-12	0.0000	2.802E-14	0.0000	2.283E-14	0.0000	1.168E+01	0.2602
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	2.140E-13	0.0000	4.482E-16	0.0000	0.000E+00	0.0000	1.654E-14	0.0000	1.857E-16	0.0000	1.512E-16	0.0000	4.899E+00	0.1091
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.199E+01	0.2670
U-234	8.613E-01	0.0192	1.183E-04	0.0000	4.937E-05	0.0000	6.625E-02	0.0015	3.147E-04	0.0000	1.209E-03	0.0000	9.440E-01	0.0210
U-235	9.233E-01	0.0206	1.870E-04	0.0000	0.000E+00	0.0000	7.103E-02	0.0016	5.013E-04	0.0000	1.167E-03	0.0000	1.101E+00	0.0245
U-238	3.295E-01	0.0185	1.098E-04	0.0000	2.245E-07	0.0000	6.380E-02	0.0014	3.020E-04	0.0000	1.166E-03	0.0000	9.037E-01	0.0201
Total	2.614E+00	0.0582	4.151E-04	0.0000	4.959E-05	0.0000	2.011E-01	0.0045	1.118E-03	0.0000	3.542E-03	0.0001	4.491E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	7.726E-01	0.0190	1.250E+00	0.0300	0.000E+00	0.0000	1.003E+01	0.2404	1.606E-01	0.0038	8.964E-04	0.0000	3.515E-01	0.0084
Ra-226	2.662E+00	0.0643	2.941E-03	0.0001	2.159E+00	0.0518	4.910E+00	0.1177	1.589E-02	0.0004	1.188E-02	0.0003	6.872E-02	0.0016
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.623E+00	0.0389	6.285E-02	0.0015	1.306E+00	0.0313	2.939E+00	0.0704	9.447E-03	0.0002	7.068E-03	0.0002	4.891E-02	0.0012
Th-232	7.068E+00	0.1694	3.689E-01	0.0088	6.375E-03	0.0002	4.323E+00	0.1036	1.225E-02	0.0003	1.420E-02	0.0003	7.914E-03	0.0019
U-234	3.197E-03	0.0001	8.980E-04	0.0000	2.563E-03	0.0001	7.345E-03	0.0002	2.374E-05	0.0000	2.686E-05	0.0000	2.280E-04	0.0000
U-235	1.353E-02	0.0003	8.354E-03	0.0002	0.000E+00	0.0000	6.322E-02	0.0015	9.935E-04	0.0000	1.809E-05	0.0000	2.282E-03	0.0001
U-238	1.235E-03	0.0000	6.896E-04	0.0000	1.425E-06	0.0000	1.566E-03	0.0000	5.165E-06	0.0000	1.264E-05	0.0000	1.243E-04	0.0000
Total	1.218E+01	0.2921	1.695E+00	0.0406	3.476E+00	0.0833	2.227E+01	0.5339	1.992E-01	0.0048	3.410E-02	0.0008	5.508E-01	0.0132

Total Dose Contributions TDose(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	8.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.258E+01	0.3017
Ra-226	3.638E-10	0.0000	7.620E-13	0.0000	0.000E+00	0.0000	2.811E-11	0.0000	3.155E-13	0.0000	2.570E-13	0.0000	9.850E+00	0.2361
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	5.219E-12	0.0000	1.093E-14	0.0000	0.000E+00	0.0000	4.033E-13	0.0000	4.528E-15	0.0000	3.628E-15	0.0000	5.997E+00	0.1438
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.187E+01	0.2847
U-234	3.744E-01	0.0090	5.779E-05	0.0000	9.162E-05	0.0000	2.880E-02	0.0007	1.385E-04	0.0000	5.236E-04	0.0000	4.183E-01	0.0100
U-235	4.759E-01	0.0114	1.447E-04	0.0000	0.000E+00	0.0000	3.662E-02	0.0009	3.740E-04	0.0000	5.054E-04	0.0000	6.019E-01	0.0144
U-238	3.577E-01	0.0086	4.737E-05	0.0000	3.235E-07	0.0000	2.751E-02	0.0007	1.302E-04	0.0000	5.028E-04	0.0000	3.895E-01	0.0093
Total	1.208E+00	0.0290	2.499E-04	0.0000	9.494E-05	0.0000	9.293E-02	0.0022	6.427E-04	0.0000	1.532E-03	0.0000	4.171E+01	1.0000

*Sum of all water independent and dependent pathways.

			Dose/Source Ratios Summed Over All Pathways											
			Parent and Progeny Principal Radionuclide Contributions Indicated											
			DSR(j,t) (mrem/yr)/(pCi/g)											
Parent (i)	Product (j)	Branch Fraction	t= 0.000E+00	1.000E+01	3.000E+01	7.000E+01	1.000E+02	2.000E+02	3.000E+02	5.000E+02	7.500E+02	1.000E+03		
Pa-231	Pa-231	1.000E+00	1.031E+01	1.028E+01	1.023E+01	1.013E+01	1.005E+01	9.808E+00	9.567E+00	9.104E+00	8.556E+00	8.041E+00		
Pa-231	Ac-227	1.000E+00	0.000E+00	1.599E+00	3.568E+00	5.112E+00	5.448E+00	5.532E+00	5.405E+00	5.144E+00	4.834E+00	4.543E+00		
Pa-231	EDSR(j)		1.031E+01	1.188E+01	1.380E+01	1.524E+01	1.550E+01	1.534E+01	1.497E+01	1.425E+01	1.339E+01	1.258E+01		
Pa-226	Pa-226	1.000E+00	1.346E+01	1.337E+01	1.318E+01	1.283E+01	1.257E+01	1.174E+01	1.096E+01	9.563E+00	8.062E+00	6.794E+00		
Pa-226	Pb-210	1.000E+00	0.000E+00	1.614E+00	3.587E+00	5.102E+00	5.390E+00	5.263E+00	4.722E+00	4.297E+00	3.622E+00	3.054E+00		
Pa-226	EDSR(j)		1.346E+01	1.498E+01	1.677E+01	1.793E+01	1.796E+01	1.700E+01	1.589E+01	1.386E+01	1.168E+01	9.850E+00		
Th-228	Th-228	1.000E+00	4.716E+00	1.258E-01	8.963E-05	4.547E-11	8.643E-16	1.584E-31	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Th-230	Th-230	1.000E+00	1.205E-01	1.204E-01	1.203E-01	1.201E-01	1.198E-01	1.193E-01	1.187E-01	1.176E-01	1.162E-01	1.148E-01		
Th-230	Ac-226	1.000E+00	0.000E+00	5.809E-02	1.730E-01	3.978E-01	5.622E-01	1.084E+00	1.570E+00	2.438E+00	3.355E+00	4.113E+00		
Th-230	Pb-210	1.000E+00	0.000E+00	3.736E-03	2.718E-02	1.053E-01	1.737E-01	4.054E-01	6.236E-01	1.015E+00	1.422E+00	1.769E+00		
Th-230	EDSR(j)		1.205E-01	1.822E-01	3.205E-01	6.232E-01	8.537E-01	1.609E+00	2.312E+00	3.570E+00	4.899E+00	5.997E+00		
Th-232	Th-232	1.000E+00	6.153E-01	6.151E-01	6.146E-01	6.136E-01	6.129E-01	6.105E-01	6.082E-01	6.034E-01	5.976E-01	5.917E-01		
Th-232	Pa-228	1.000E+00	0.000E+00	4.895E+00	6.795E+00	6.971E+00	6.964E+00	6.937E+00	6.910E+00	6.856E+00	6.789E+00	6.723E+00		
Th-232	Th-228	1.000E+00	0.000E+00	2.678E+00	4.545E+00	4.726E+00	4.722E+00	4.704E+00	4.685E+00	4.649E+00	4.604E+00	4.559E+00		
Th-232	EDSR(j)		6.153E-01	8.190E+00	1.195E+01	1.231E+01	1.230E+01	1.225E+01	1.220E+01	1.211E+01	1.199E+01	1.187E+01		
U-234	U-234	1.000E+00	8.832E-02	8.523E-02	7.937E-02	1.498E-01	3.013E-01	7.088E-01	9.999E-01	1.356E+00	9.327E-01	4.015E-01		
U-234	Th-230	1.000E+00	0.000E+00	1.069E-05	3.087E-05	6.722E-05	9.211E-05	1.645E-04	2.244E-04	3.210E-04	4.100E-04	4.888E-04		
U-234	Pa-226	1.000E+00	0.000E+00	2.587E-06	2.263E-05	1.165E-04	2.282E-04	8.012E-04	1.593E-03	3.517E-03	6.104E-03	8.557E-03		
U-234	Pb-210	1.000E+00	0.000E+00	1.156E-07	2.573E-06	2.411E-05	5.847E-05	2.974E-04	7.244E-04	2.104E-03	4.710E-03	7.783E-03		
U-234	EDSR(j)		8.832E-02	8.524E-02	7.943E-02	1.501E-01	3.017E-01	7.101E-01	1.002E+00	1.362E+00	9.440E-01	4.183E-01		
U-235	U-235	1.000E+00	3.868E-01	3.733E-01	3.477E-01	3.795E-01	5.014E-01	8.303E-01	1.066E+00	1.357E+00	9.197E-01	3.958E-01		
U-235	Pa-231	1.000E+00	0.000E+00	2.139E-03	6.176E-03	1.541E-02	1.841E-02	3.335E-02	4.629E-02	6.851E-02	9.011E-02	9.834E-02		
U-235	Ac-227	1.000E+00	0.000E+00	1.774E-04	1.267E-03	4.673E-03	7.572E-03	1.843E-02	3.063E-02	5.764E-02	9.129E-02	1.078E-01		
U-235	EDSR(j)		3.868E-01	3.756E-01	3.551E-01	3.976E-01	5.274E-01	8.820E-01	1.143E+00	1.483E+00	1.101E+00	6.019E-01		
U-238	U-238	1.000E+00	1.267E-01	1.223E-01	1.139E-01	1.767E-01	3.191E-01	7.025E-01	9.766E-01	1.313E+00	9.017E-01	3.884E-01		
U-238	U-234	1.000E+00	0.000E+00	2.417E-06	6.742E-06	2.968E-05	8.528E-05	4.012E-04	8.467E-04	1.920E-03	1.980E-03	1.138E-03		
U-238	Th-230	1.000E+00	0.000E+00	1.508E-10	1.288E-09	6.401E-09	1.248E-08	4.324E-08	8.535E-08	1.945E-07	3.584E-07	4.534E-07		
U-238	Pa-226	1.000E+00	0.000E+00	2.427E-11	6.301E-10	7.593E-09	2.300E-08	1.645E-07	4.735E-07	1.663E-06	3.925E-06	6.151E-06		
U-238	Pb-210	1.000E+00	0.000E+00	8.374E-13	5.640E-11	2.889E-09	2.741E-08	3.000E-07	9.602E-07	4.247E-06	1.137E-05	1.665E-05		
U-238	EDSR(j)		1.267E-01	1.223E-01	1.139E-01	1.767E-01	3.192E-01	7.029E-01	9.775E-01	1.315E+00	9.037E-01	3.897E-01		

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)*...BRF(j).
The DSR includes contributions from associated (half-life < 0.5 yr) daughters.

Single Radionuclide Soil Guidelines $G(i,t)$ in pCi/g
Basic Radiation Dose Limit = 500 mrem/yr

Radionuclide (i)	$t = 0.000E+00$	$1.000E+01$	$3.000E+01$	$7.000E+01$	$1.000E+02$	$2.000E+02$	$3.000E+02$	$5.000E+02$	$7.500E+02$	$1.000E+03$
Fr-221	4.851E+01	4.209E+01	3.624E+01	3.280E+01	3.225E+01	3.259E+01	3.339E+01	3.509E+01	3.734E+01	3.973E+01
Ra-226	5.715E+01	3.338E+01	2.991E+01	2.788E+01	2.784E+01	2.941E+01	3.147E+01	3.607E+01	4.279E+01	5.076E+01
Th-228	1.060E+02	3.973E+03	5.378E+06	1.100E+13	*8.192E+14	*9.192E+14	*8.192E+14	*8.192E+14	*8.192E+14	*8.192E+14
Th-230	4.151E+03	2.744E+03	1.560E+03	8.023E+02	5.843E+02	3.107E+02	2.163E+02	1.400E+02	1.021E+02	8.338E+01
Th-232	8.124E+02	6.105E+01	4.182E+01	4.062E+01	4.065E+01	4.081E+01	4.097E+01	4.129E+01	4.170E+01	4.211E+01
U-234	5.662E+03	5.866E+03	6.295E+03	3.332E+03	1.657E+03	7.041E+02	4.988E+02	3.671E+02	3.297E+02	1.195E+03
U-235	1.293E+03	1.331E+03	1.408E+03	1.258E+03	9.481E+02	5.669E+02	4.374E+02	3.372E+02	4.541E+02	8.307E+02
U-238	3.947E+03	4.090E+03	4.391E+03	2.830E+03	1.566E+03	7.114E+02	5.115E+02	3.803E+02	5.533E+02	1.284E+03

*At specific activity limit

0

Summed Dose/Source Ratios $DSR(i,t)$ in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines $G(i,t)$ in pCi/g
at t_{min} = time of minimum single radionuclide soil guideline
and at t_{max} = time of maximum total dose = 247.5 \pm 0.2 years

Radionuclide (i)	Initial pCi/g	t_{min} (years)	$DSR(i, t_{min})$	$G(i, t_{min})$ (pCi/g)	$DSR(i, t_{max})$	$G(i, t_{max})$ (pCi/g)
Fr-221	1.000E+00	120.5 \pm 0.1	1.554E+01	3.219E+01	1.517E+01	3.297E+01
Ra-226	1.000E+00	86.03 \pm 0.09	1.799E+01	2.779E+01	1.647E+01	3.036E+01
Th-228	1.000E+00	9.000E+00	4.716E+00	1.060E+02	0.000E+00	*8.192E+14
Th-230	1.000E+00	1.000E+03	5.997E+00	8.338E+01	1.949E+00	2.545E+02
Th-232	1.000E+00	67.67 \pm 0.07	1.231E+01	4.062E+01	1.223E+01	4.089E+01
U-234	1.000E+00	613.8 \pm 0.6	1.482E+00	3.374E+02	8.611E-01	5.807E+02
U-235	1.000E+00	613.8 \pm 0.6	1.608E+00	3.110E+02	1.016E+00	4.922E+02
U-238	1.000E+00	614.0 \pm 0.6	1.427E+00	3.504E+02	8.447E-01	5.919E+02

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BAF(i)	DOSE(j,t), mrem/yr											
			t=	0.000E+00	1.000E+01	3.000E+01	7.000E+01	1.000E+02	2.000E+02	3.000E+02	5.000E+02	7.500E+02	1.000E+03	
Pa-231	Pa-231	1.000E+00		1.031E+01	1.028E+01	1.023E+01	1.013E+01	1.005E+01	9.808E+00	9.367E+00	9.104E+00	8.556E+00	8.041E+00	
Pa-231	U-235	1.000E+00		0.000E+00	2.139E-03	6.176E-03	1.341E-02	1.841E-02	3.335E-02	4.629E-02	6.851E-02	9.011E-02	9.834E-02	
Pa-231	EDOSE(j):			1.031E+01	1.028E+01	1.024E+01	1.014E+01	1.007E+01	9.841E+00	9.614E+00	9.172E+00	8.646E+00	8.139E+00	
Ac-227	Pa-231	1.500E+00		0.000E+00	1.599E+00	3.568E+00	5.112E+00	5.448E+00	5.332E+00	5.405E+00	5.144E+00	4.834E+00	4.543E+00	
Ac-227	U-235	1.000E+00		0.000E+00	1.774E-04	1.267E-03	4.673E-03	7.572E-03	1.843E-02	3.063E-02	5.764E-02	9.129E-02	1.078E-01	
Ac-227	EDOSE(j):			0.000E+00	1.599E+00	3.569E+00	5.117E+00	5.456E+00	5.351E+00	5.436E+00	5.201E+00	4.925E+00	4.651E+00	
Ra-226	Ra-226	1.000E+00		1.346E+01	1.337E+01	1.318E+01	1.283E+01	1.257E+01	1.174E+01	1.096E+01	9.563E+00	8.062E+00	6.796E+00	
Ra-226	Th-230	1.000E+00		0.000E+00	5.809E-02	1.730E-01	3.978E-01	5.622E-01	1.064E+00	1.570E+00	2.438E+00	3.355E+00	4.113E+00	
Ra-226	U-234	1.000E+00		0.000E+00	2.587E-06	2.263E-05	1.165E-04	2.282E-04	8.012E-04	1.593E-03	3.517E-03	6.104E-03	8.557E-03	
Ra-226	U-238	1.000E+00		0.000E+00	2.627E-11	6.301E-10	7.593E-09	2.300E-08	1.645E-07	4.735E-07	1.663E-06	3.925E-06	6.151E-06	
Ra-226	EDOSE(j):			1.346E+01	1.342E+01	1.375E+01	1.323E+01	1.313E+01	1.282E+01	1.233E+01	1.201E+01	1.142E+01	1.092E+01	
Pb-210	Ra-226	1.000E+00		0.000E+00	1.614E+00	3.587E+00	5.102E+00	5.390E+00	5.263E+00	4.926E+00	4.297E+00	3.622E+00	3.054E+00	
Pb-210	Th-230	1.000E+00		0.000E+00	3.736E-03	2.718E-02	1.053E-01	1.737E-01	4.054E-01	6.236E-01	1.015E+00	1.428E+00	1.769E+00	
Pb-210	U-234	1.000E+00		0.000E+00	1.156E-07	2.573E-06	2.411E-05	5.847E-05	2.974E-04	7.244E-04	2.104E-03	4.710E-03	7.783E-03	
Pb-210	U-238	1.000E+00		0.000E+00	8.374E-13	5.640E-11	2.889E-09	2.741E-08	3.000E-07	9.602E-07	4.247E-06	1.137E-05	1.665E-05	
Pb-210	EDOSE(j):			0.000E+00	1.617E+00	3.614E+00	5.208E+00	5.564E+00	5.669E+00	5.350E+00	5.314E+00	5.055E+00	4.831E+00	
Th-228	Th-228	1.000E+00		4.716E+00	1.258E-01	8.963E-05	4.547E-11	8.643E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Th-228	Th-232	1.000E+00		0.000E+00	2.679E+00	4.545E+00	4.776E+00	4.722E+00	4.704E+00	4.685E+00	4.649E+00	4.604E+00	4.559E+00	
Th-228	EDOSE(j):			4.716E+00	2.805E+00	4.545E+00	4.726E+00	4.722E+00	4.704E+00	4.685E+00	4.649E+00	4.604E+00	4.559E+00	
Th-230	Th-230	1.000E+00		2.05E-01	1.204E-01	1.202E-01	1.201E-01	1.199E-01	1.193E-01	1.187E-01	1.176E-01	1.162E-01	1.148E-01	
Th-230	U-234	1.000E+00		0.000E+00	1.069E-05	3.087E-05	6.722E-05	9.211E-05	1.645E-04	2.244E-04	3.210E-04	4.100E-04	4.888E-04	
Th-230	U-238	1.000E+00		0.000E+00	1.508E-10	1.288E-09	6.401E-09	1.248E-08	4.324E-08	8.535E-08	1.965E-07	3.584E-07	4.636E-07	
Th-230	EDOSE(j):			1.205E-01	1.204E-01	1.203E-01	1.201E-01	1.200E-01	1.195E-01	1.190E-01	1.179E-01	1.166E-01	1.153E-01	
Th-232	Th-232	1.000E+00		6.153E-01	6.151E-01	6.146E-01	6.136E-01	6.129E-01	6.105E-01	6.082E-01	6.034E-01	5.976E-01	5.917E-01	
Ra-226	Th-232	1.000E+00		0.000E+00	4.895E+00	6.795E+00	6.971E+00	6.964E+00	6.937E+00	6.910E+00	6.856E+00	6.789E+00	6.723E+00	
U-234	U-234	1.000E+00		8.832E-02	8.523E-02	7.937E-02	1.498E-01	3.013E-01	7.088E-01	9.999E-01	1.356E+00	9.327E-01	4.015E-01	
U-234	U-238	1.000E+00		0.000E+00	2.417E-06	6.742E-06	2.968E-05	8.528E-05	4.012E-04	8.467E-04	1.920E-03	1.980E-03	1.138E-03	
U-234	EDOSE(j):			8.832E-02	8.523E-02	7.938E-02	1.499E-01	3.014E-01	7.092E-01	1.001E+00	1.358E+00	9.347E-01	4.026E-01	
U-235	U-235	1.000E+00		3.868E-01	3.733E-01	3.477E-01	3.795E-01	5.014E-01	8.303E-01	1.066E+00	1.357E+00	9.197E-01	3.958E-01	
U-238	U-238	1.000E+00		1.267E-01	1.223E-01	1.139E-01	1.767E-01	3.191E-01	7.025E-01	9.746E-01	1.313E+00	9.017E-01	3.884E-01	

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

DNuclide	Parent	BRF(1)	E(t), pCi/g									
(j)	(i)		t= 0.000E+00	1.000E+01	3.000E+01	7.000E+01	1.000E+02	2.000E+02	3.000E+02	5.000E+02	7.500E+02	1.000E+03
Pa-231	Pa-231	1.000E+00	1.000E+00	9.975E-01	9.926E-01	9.828E-01	9.755E-01	9.515E-01	9.287E-01	8.832E-01	8.301E-01	7.801E-01
Pa-231	U-235	1.000E+00	0.000E+00	2.074E-04	5.991E-04	1.298E-03	1.755E-03	2.942E-03	3.732E-03	4.564E-03	4.860E-03	4.803E-03
Pa-231	ES(j):		1.000E+00	9.977E-01	9.932E-01	9.841E-01	9.772E-01	9.545E-01	9.319E-01	8.878E-01	8.349E-01	7.849E-01
QAc-227	Pa-231	1.000E+00	0.000E+00	2.724E-01	6.111E-01	8.768E-01	9.345E-01	9.491E-01	9.273E-01	8.824E-01	8.294E-01	7.794E-01
Ac-227	U-235	1.000E+00	0.000E+00	2.997E-05	2.164E-04	7.990E-04	1.266E-03	2.578E-03	3.475E-03	4.435E-03	4.805E-03	4.777E-03
Ac-227	ES(j):		0.000E+00	2.724E-01	6.113E-01	8.776E-01	9.358E-01	9.516E-01	9.308E-01	8.869E-01	8.341E-01	7.842E-01
ORa-226	Ra-226	1.000E+00	1.000E+00	9.932E-01	9.787E-01	9.533E-01	9.340E-01	8.723E-01	8.147E-01	7.107E-01	5.991E-01	5.050E-01
Ra-226	Th-230	1.000E+00	0.000E+00	4.316E-03	1.285E-02	2.956E-02	4.177E-02	8.059E-02	1.166E-01	1.812E-01	2.493E-01	3.056E-01
Ra-226	U-234	1.000E+00	0.000E+00	1.922E-07	1.682E-06	8.657E-06	1.695E-05	5.927E-05	1.172E-04	2.553E-04	4.347E-04	5.997E-04
Ra-226	U-238	1.000E+00	0.000E+00	1.803E-12	4.682E-11	3.505E-10	1.515E-09	1.004E-08	2.822E-08	9.198E-08	2.059E-07	3.335E-07
Ra-226	ES(j):		1.000E+00	9.975E-01	9.926E-01	9.829E-01	9.758E-01	9.529E-01	9.315E-01	8.921E-01	8.409E-01	8.113E-01
OPb-210	Ra-226	1.000E+00	0.000E+00	2.656E-01	5.958E-01	8.494E-01	8.977E-01	8.767E-01	8.204E-01	7.157E-01	6.034E-01	5.086E-01
Pb-210	Th-230	1.000E+00	0.000E+00	6.062E-04	4.491E-03	1.749E-02	2.888E-02	6.767E-02	1.038E-01	1.690E-01	2.378E-01	2.946E-01
Pb-210	U-234	1.000E+00	0.000E+00	1.850E-08	4.231E-07	3.989E-06	5.537E-06	4.417E-05	9.677E-05	2.291E-04	4.063E-04	5.713E-04
Pb-210	U-238	1.000E+00	0.000E+00	1.322E-13	9.231E-12	2.082E-10	7.188E-10	6.692E-09	2.156E-08	7.898E-08	1.876E-07	3.126E-07
Pb-210	ES(j):		0.000E+00	2.662E-01	6.003E-01	8.649E-01	9.266E-01	9.442E-01	9.244E-01	8.849E-01	8.415E-01	8.038E-01
OTh-228	Th-228	1.000E+00	1.000E+00	2.669E-02	1.901E-05	9.642E-12	1.833E-16	3.359E-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	5.632E-01	9.569E-01	9.952E-01	9.944E-01	9.905E-01	9.866E-01	9.789E-01	9.694E-01	9.600E-01
Th-228	ES(j):		1.000E+00	5.899E-01	9.569E-01	9.952E-01	9.944E-01	9.905E-01	9.866E-01	9.789E-01	9.694E-01	9.600E-01
OTh-230	Th-230	1.000E+00	1.000E+00	9.995E-01	9.985E-01	9.966E-01	9.952E-01	9.904E-01	9.857E-01	9.763E-01	9.646E-01	9.531E-01
Th-230	U-234	1.000E+00	0.000E+00	8.842E-05	2.560E-04	5.568E-04	7.555E-04	1.281E-03	1.646E-03	2.071E-03	2.296E-03	2.371E-03
Th-230	U-238	1.000E+00	0.000E+00	1.243E-09	1.067E-08	5.288E-08	1.006E-07	3.205E-07	5.783E-07	1.057E-06	1.474E-06	1.706E-06
Th-230	ES(j):		1.000E+00	9.996E-01	9.988E-01	9.972E-01	9.960E-01	9.917E-01	9.873E-01	9.783E-01	9.669E-01	9.554E-01
OTh-232	Th-232	1.000E+00	1.000E+00	9.996E-01	9.988E-01	9.973E-01	9.961E-01	9.922E-01	9.834E-01	9.807E-01	9.711E-01	9.617E-01
ORa-226	Th-232	1.000E+00	0.000E+00	6.990E-01	9.703E-01	9.953E-01	9.944E-01	9.905E-01	9.866E-01	9.789E-01	9.694E-01	9.600E-01
OU-234	U-234	1.000E+00	1.000E+00	9.650E-01	8.988E-01	7.795E-01	7.006E-01	4.909E-01	3.439E-01	1.688E-01	6.936E-02	2.850E-02
U-234	U-238	1.000E+00	0.000E+00	2.730E-05	7.629E-05	1.544E-04	1.982E-04	2.778E-04	2.920E-04	2.390E-04	1.473E-04	8.074E-05
U-234	ES(j):		1.000E+00	9.651E-01	8.988E-01	7.797E-01	7.008E-01	4.911E-01	3.442E-01	1.690E-01	6.951E-02	2.854E-02
OU-235	U-235	1.000E+00	1.000E+00	9.651E-01	8.988E-01	7.797E-01	7.008E-01	4.911E-01	3.442E-01	1.690E-01	6.951E-02	2.854E-02
OU-238	U-238	1.000E+00	1.000E+00	9.651E-01	8.988E-01	7.797E-01	7.008E-01	4.911E-01	3.442E-01	1.690E-01	6.951E-02	2.854E-02

BRF(1) is the branch fraction of the parent nuclide.

EXHIBIT 10

EXHIBIT 10

REAL ESTATE DISCLOSURE LANGUAGE

Residential Property Disclosure Form I

Plaintiff class members agree to append the following statement to the Residential Property Disclosure Form required pursuant to Ohio Revised Code Section 5302.30:

INFORMATION CONCERNING THE PROPERTY

The subject property was included within a class action lawsuit claiming, among other things, property diminution. That lawsuit was captioned *Strawsburg, et al. v. Metallurg, et al.*, U.S. District Court (S.D. Ohio), Case No. C2-94-1069, consolidated with *Malernee, et al. v. Cabot Corporation, et al.*, U.S. District Court (S.D. Ohio), Case No. C2-95-248 filed on November 7, 1994 in Federal District Court for the Southern District of Ohio, Columbus, Ohio. That consolidated lawsuit was settled on June 14, 1996 and the settlement was approved by the Court on _____.

FILED

STAMP OF AMERICAN
U.S. DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLAN STRAWSBURG, SUZANNE
STRAWSBURG, STEVE M. BESKID,
JILL BESKID, and LINDA STEWART,
individually and on behalf of all others
similarly situated,

Plaintiffs,

vs.

METALLURG, INC., et al.,

Defendants.

CASE NO: C-2-94-1069

STIPULATION FOR
PROVISIONAL CLASS
CERTIFICATION FOR
SETTLEMENT PURPOSES
BETWEEN CYPRUS FOOTE
MINERAL COMPANY AND
REPRESENTATIVE PLAINTIFFS
AND [PROPOSED] ORDER

Hon. Judge Smith
Hon. Magistrate Judge King

STIPULATION

Representative Plaintiffs ALLAN STRAWSBURG, SUSAN STRAWSBURG, STEVE M. BESKID, JILL BESKID, and LINDA STEWART, by and through their Counsel, and CYPRUS FOOTE MINERAL COMPANY (Defendant), through its Designee, entered into this Agreement and Stipulation (this "Agreement") as of April 20, 1995.

RECITALS

WHEREAS, a class action complaint styled *Strawsburg v. Metallurg, Inc., et al.*, Case No. C2-94-1069 (S.D. Ohio 1994), was filed in this Court on November 7, 1994 alleging injury to Representative Plaintiffs and the Class arising from the presence of radioactivity allegedly caused by radioactive contaminated slag used as fill at and around

plaintiffs' properties;

WHEREAS, the action seeks injunctive and equitable relief, including, among other things: (1) an order compelling Defendant to test the properties of the Class potentially affected by the presence of the alleged radioactive slag described herein; (2) an order compelling Defendant to remediate the properties of the Class potentially affected by the presence of the alleged radioactive slag described herein; (3) an order compelling Defendant to establish and fund a medical monitoring program; (4) an order compelling Defendant to establish and fund a personal injury claims evaluation program consistent with the terms of the Settlement Agreement reached between the parties; and (5) an order enjoining Defendant from further participation in proceedings arising from the same facts except as authorized by this Court ;

WHEREAS, the "Strawburg Class Action Complaint for Injunctive and Equitable Relief" (the "Action") alleges claims for injuries against Defendant on behalf of

(i) All persons who own or have owned property or reside or have resided on property contaminated by the presence of radioactive slag (whether or not subsequently removed) subsequent to the date which said slag was directly or indirectly manufactured, developed, designed, fabricated, sold, marketed, owned, produced, shipped, distributed or otherwise placed on the property by Defendant; and

(ii) All persons who claim or could make a claim for medical monitoring or any physical injury or impairment as a result of presence of radioactive slag described in subparagraph (i) above;

WHEREAS, Representative Plaintiffs and Defendant have conducted extensive investigations and discovery as to the merits of the claims asserted in the Action, and have engaged in negotiations concerning the disposition of those claims;

WHEREAS, the parties to this Stipulation have been engaged in settlement discussions aimed at the resolution of this Action, and anticipate that a final Settlement agreement can be reached within six (6) months of the date of the filing of this Stipulation, or this Stipulation shall be vacated by its own terms;

WHEREAS, in addition, a second class action styled, *Malernee, et al. v. Cabot Corporation*, Case No. C2-95-243 (S.D. Ohio 1995), against Defendant based on the same product(s) and facts was filed on March 6, 1995 and is now pending in this Court before Honorable Judge Kinneary, and future actions may be filed, which may result in the rendering of inconsistent rulings and prescribe inconsistent relief;

WHEREAS, it is alleged that the possibility of inconsistent or varying adjudications with respect to individual members of the Settlement Class could establish incompatible standards of conduct for Defendant with respect to Plaintiffs' claims for equitable and injunctive relief within the meaning of Fed.R.Civ.P. 23(b)(1)(A);

WHEREAS, it is alleged that Defendant has acted or refused to act on grounds generally applicable to the Settlement Class, thereby making final injunctive relief appropriate with respect to the class as a whole in accordance with Fed.R.Civ.P. 23(b)(2);

WHEREAS, Defendant has denied, and continues to deny, Representative Plaintiffs' claims and contentions in the Action including, but not limited to, those related to class certification, and has denied, and continues to deny, any wrongdoing or any legal liability of any kind;

WHEREAS, Representative Plaintiffs acknowledge that the continued prosecution of the Action against Defendant through trial and appeals will require considerable expense and time. Representative Plaintiffs also recognize the uncertainty and the risk of litigation. Representative Plaintiffs have determined that the settlement of the claims in the Action against Defendant in accordance with this Agreement would be beneficial to the Settlement Class;

WHEREAS, Defendant understands that the further prosecution of the Action against it would be protracted and expensive. Defendant would have to devote substantial amounts of time and resources to the defense of the claims asserted in the Action. Defendant has determined that the settlement of the claims in the Action against it in accordance with this Agreement is therefore appropriate;

WHEREAS, the parties intend by this settlement to resolve all present and

future claims against Defendant on behalf of all class members whose claims have been or may be brought in the United States, on a mandatory basis, in order to inclusively and equitably resolve all present and future claims under Rule 23 (b)(1) and Rule 23 (b)(2);

WHEREAS, the injunctive relief sought is of paramount importance to plaintiffs and is the integral component of any integrated settlement between the parties;

WHEREAS, Defendant has instituted an investigation and has been actively working with the United States Nuclear Regulatory Commission and is negotiating with the Ohio Environmental Protection Agency to determine the nature and scope of any problem for close to one year and Plaintiffs seek to be kept informed in this process;

WHEREAS, the United States Nuclear Regulatory Commission has concluded that no immediate health and safety concern exists and Defendant intends, without the admission of any liability, to enter an order with the appropriate government agency to characterize the slag, to assess any potential future risks and evaluate any potential abatement action and Representative Plaintiffs do not wish to interfere with these actions taken in their respective interests but rather monitor the process on behalf of the class.

THEREFORE, Representative Plaintiffs, on their own behalf and on behalf of the Settlement Class, and Defendant hereby stipulate and agree, through Plaintiffs' Counsel and Defendant's Designee, respectively, that

1. This Action shall be certified conditionally as a class action pursuant to Federal Rule of Civil Procedure 23(b)(1)(A) and/or (b)(2) for purposes of settlement only. In the event that a settlement cannot be reached, this Stipulation shall terminate and be null and void and Plaintiffs shall have 30 days to file for class certification with the Court. Further, regardless of whether a settlement is reached, Plaintiffs' counsel agrees that it will not seek attorney fees associated with the Defendants undertaking any investigation, remediation, and/or other injunctive relief in response to regulatory enforcement. If there is any dispute between the parties as to what investigation, remediation and/or injunctive relief is undertaken in response to regulatory action as opposed to this civil action, for the purposes of any claims for attorneys fees, the parties agree that this Court shall have jurisdiction to resolve such

dispute.

2. The parties shall negotiate in good faith and use their best efforts to finalize the terms of the Final Settlement Agreement, currently under negotiation, within six (6) months of the date of this Stipulation; and

3. The undersigned Plaintiffs' Counsel, namely The Alexander Law Firm, shall be appointed as Lead Class Counsel in this Action for purposes of negotiating this Settlement. Defendant shall not be required to negotiate with any other party or counsel on behalf of the class or any of its individual members; and

4. This Court, by the Honorable Judge Smith and the Honorable Magistrate Judge King, shall retain continuing jurisdiction over this class action for all purposes, and in particular for the negotiations contemplated by this Stipulation.

IN WITNESS WHEREOF, this Agreement has been executed as of the 20 day of April, 1995, by the undersigned counsel of record for the parties hereto, thereunto duly authorized.

On behalf of Defendant
Cyprus Foote Mineral Company

DEFENDANT'S COUNSEL

By: 

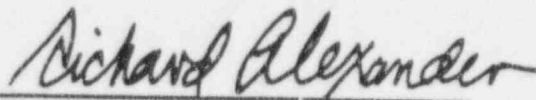
Robert Casarona, Esq.
CLIMACO, CLIMACO, SEMINATORE,
LEFKOWITZ & GAROPOLI CO., L.P.A.
Suite 900, The Halle Building
1228 Euclid Avenue
Cleveland, OH 44115

Of counsel:

John R. Climaco, Esq.
Thomas M. Wilson, Esq.
Paul D. Jesse, Esq.

On behalf of the Representative Plaintiffs

PLAINTIFFS' CLASS COUNSEL



Richard Alexander, Esq.
Mark P. Rapazzini, Esq.
M. Elizabeth Graham, Esq.
THE ALEXANDER LAW FIRM
55 S. Market Street, Suite 1080
San Jose, CA 95113

IT IS SO ORDERED:

Dated: APR 21 1995

/S/ GEORGE C. SMITH

Honorable Judge Smith

5
K
P
6-19-95

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

FILED
KENNETH J. MURPHY
CLERK

55 JUN 19 PM 3:52

U.S. DISTRICT COURT
SOUTHERN DIST. OHIO
EASTERN DIVISION COLUMBUS

ALLEN STRAWSBURG, et al.,
Plaintiffs,

vs.

Civil Action 2:94-CV-1069

METALLURGIC, INC., et al.,
Defendants,

and

SUE ANN MALERMEER, et al.,
Plaintiffs,

vs.

Civil Action 2:95-CV-248

CABOT CORPORATION, et al.,
Defendants.

ORDER

A status conference was held in these cases on June 14, 1995. Counsel for all parties participated.

With the consent of all the parties, these actions are hereby ORDERED CONSOLIDATED for all purposes. It is agreed that the parties will attempt to negotiate terms of settlement of these two cases and that, for such purposes, the Alexander law firm will be lead counsel for the plaintiff class.

No later than June 26, 1995, the parties will submit a proposed notice to the plaintiff class.

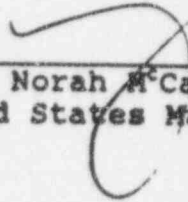
EXHIBIT 3

1

A number of motions are pending in Malvernee. Counsel for the parties will submit to the Court, no later than June 21, 1995, reports on the status of those motions and of the positions of the parties regarding the possibility of stay of further proceedings on any or all of those motions.

Further filings on the pending motions are hereby ORDERED STAYED until further order of the Court.

The conference currently scheduled for July 13, 1995 is VACATED. Another status conference will be held in late August or early September 1995.



Norah M. Cann King
United States Magistrate Judge

UNITED STATES COURT OF APPEALS
FOR THE SIXTH CIRCUIT

FILED

JUN 2 1995

In re: SUE ANN MALERNEE; EDWARD
K. MALERNEE.

Petitioners.

LEONARD GREEN, Clerk

ORDER

Before: KRUPANSKY, MILBURN, and BATCHELDER, Circuit Judges.

Petitioners seek a writ of mandamus directing the district court to vacate an order conditionally certifying a settlement class in an action seeking injunctive relief and damages arising from the presence of radioactive waste materials on property in Guernsey County, Ohio. Petitioners are unnamed members of the conditionally certified class and are plaintiffs in a similar class action pending in the district court.

"The remedy of mandamus is a drastic one, to be invoked only in extraordinary situations where the petitioner can show a clear and indisputable right to the relief sought. It cannot be used to control a district court in the exercise of discretionary duties." *In re American President Lines, Ltd.*, 929 F.2d 226, 227 (6th Cir. 1991) (order) (citations omitted). As a general rule, orders with respect to class certification are reviewable on appeal from the final judgment, and not subject to review in mandamus. *See In re NLO, Inc.*, 5 F.3d 154, 159 (6th Cir. 1993). The class certification in this case is a conditional certification that does not conclusively determine the rights of any member of the class. In the event that a settlement among the parties is reached, a notice of the class certification and proposed settlement will be sent to the putative

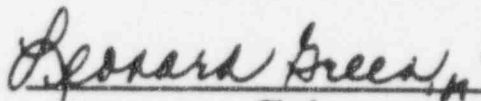
EXHIBIT 4

members of the settlement class. Such class members will have the opportunity to object to class certification as well as to the proposed settlement. *In re GMC Pick-Up Truck Fuel Tank Product Liability Litigation*, Nos. 94-1064, etc., 1995 WL 223209 at *18 (3d Cir. April 17, 1995) ("objecting class members can still challenge the class on commonality, typicality, adequacy of representation, superiority, and predominance grounds -- they are not limited to objections based strictly on the settlement's terms."); see Rule 23(e), Fed. R. Civ. P.

Petitioners have not formally intervened in the district court action and their standing to bring this petition is not clearly established. *Cf. Shultz v. Champion International Corp.*, 35 F.3d 1056, 1061 (6th Cir. 1994) (a non-named class member who has not formally intervened may not have standing to appeal). However, because the conditional certification of a settlement class was not a clear abuse of discretion, review in mandamus is not warranted.

It therefore is ORDERED that the petition for a writ of mandamus is denied.

ENTERED BY ORDER OF THE COURT


Clerk

ULMER & BERNE

ATTORNEYS AT LAW

Bond Court Building
1300 East Ninth Street, Suite 900
Cleveland, Ohio 44114-1583
Telecopier (216) 621-7488 Telex 201999 UBLAW
(216) 621-8400

In Columbus
88 East Broad Street, Suite 1980
Columbus, Ohio 43215-3506
Telecopier (614) 228-8561
Telephone (614) 228-8400

STEVEN D. BELL

June 21, 1995

Magistrate Judge Norah M. King
U. S. District Court
Southern District of Ohio
85 Marconi Boulevard
260 U.S. Courthouse
Columbus, OH 43215

RE: *Strawsburg et al. vs. Metallurg, Inc. et al.*
Case No. C2-94-1069

Dear Magistrate Judge King:

In response to the Court's recent Order, counsel for the Plaintiffs have the following position with respect to the Stay of the litigation in this matter:

1) Counsel for the Plaintiffs have reached an agreement with counsel for Defendant Newmont Mining Corporation to voluntarily dismiss Newmont Mining Corporation as a Defendant without prejudice. In exchange, Newmont Mining Corporation has agreed to execute a tolling agreement. Plaintiffs believe that a similar agreement will also be acceptable to Defendant Cabot Corporation.

2) Counsel for the Plaintiffs and counsel for Defendant Cyprus Foote Mineral Company have agreed to stay a determination of the pending cross-motions for summary judgment.

The only other Motions left unresolved by the foregoing agreements is the pending Motion of Defendant Cyprus Amax Mineral to Dismiss. Counsel for Cyprus Amax has informed counsel for the Plaintiffs that Cyprus Amax is unwilling to stay the resolution of this Motion. Counsel for Cyprus Amax has also informed counsel for Plaintiffs that Cyprus Amax will not accept a voluntary dismissal without prejudice in exchange for a tolling agreement.

EXHIBIT 5

ULMER & BERNE

Magistrate Judge Norah M. King
June 21, 1995
Page 2

The Plaintiffs believe that a stay of Cyprus Amax' Motion to Dismiss is appropriate for the following reasons:

1. Following a series of discussions, counsel for the Plaintiff-class in the *Strawburg* action and counsel for the Plaintiffs in the *Malernee* action have reached an agreement by which they will cooperate in the prosecution of this litigation. Counsel for Defendant Cyprus Foote Minerals Company has agreed to continue settlement discussions with the Plaintiffs. Plaintiffs believe that all of their energies should now be directed towards the negotiation of a settlement of this matter within the shortest possible time. The devotion of further resources to the litigation of this action is inconsistent with the agreement of counsel to attempt to conclude a negotiated settlement.
2. Cyprus Amax' Motion is made pursuant to Rule 12(b), Federal Rules of Civil Procedure. In the event that the Court grants Cyprus Amax' Motion, the Plaintiffs may be required to divert their attention from settlement discussions to prosecuting any adverse decision. This diversion of resources is not in the best interest of the class.

Plaintiffs respectfully request that resolution of Cyprus Amax' pending Motion to Dismiss be stayed.

Very truly yours,

Steven D. Bell /KH

Steven D. Bell

145:kmh

cc: Mark P. Rapazzini, Esq.
All Counsels of Record

605
Date: 7/10/95
Docket: 20

FILED
KENNETH J. MURPHY
CLERK

95 JUL 10 PM 2:05

U.S. DISTRICT COURT
SOUTHERN DIST. OHIO
EAST. DIV. COLUMBUS

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

ALLAN STRAWSBURG, individually and
on behalf of all others similarly situated,

Plaintiffs,

vs.

METALLURG, INC., et al.,

Defendants.

CASE NO: C-2-94-1069

NOTICE OF CLASS ACTION
AND APPOINTMENT OF CLASS
COUNSEL FOR SETTLEMENT
NEGOTIATIONS WITH CYPRUS
FOOTE MINERAL COMPANY

Please read this entire notice carefully.

TO: <Name and Address>

On November 7, 1994, a class action complaint, *Strawsburg v. Metallurg, Inc., et al.*, Case No. C2-94-1069, was filed alleging that harmful slag originally created at the ShieldAlloy plant in Byesville, Ohio, was used as fill at and around the properties of Representative Plaintiffs and class members. Another class action based upon the same operative facts was filed on March 16, 1995, *Malernee, et al. v. Cabot Corporation, et al.*, Case No. C2-95-248. One of the defendants alleged to be responsible in both lawsuits is Cyprus Foote Mineral Company. These cases have been consolidated into one lawsuit.

The Representative Plaintiffs in the action seek relief on behalf of all residents that may be similarly affected by the presence of the radioactive slag that was originally created at the ShieldAlloy Corporation ferroalloy plant in Byesville, Ohio.

On April 21, 1995, the Honorable Judge Smith of the United States District Court for the Southern District of Ohio, Eastern Division District, issued an order granting provisional

class action certification so that settlement discussions can occur. Cyprus Foote Mineral Company has entered into settlement discussions with The Alexander Law Firm on your behalf and The Alexander Law Firm has been designated as lead class counsel. The law firm of Ulmer & Berne, counsel in the *Malernee* case, is working with The Alexander Law Firm as associate class counsel.

The order contemplates settlement negotiations will occur to address potential concerns of the class. The settlement class for the purposes of these negotiations is defined as:

- (i) All residential property owners, from 1953 to present, who own or have owned property and/or all persons who reside or have resided on property, from 1953 to the present, that has been radioactively contaminated by the presence of slag created at the Byesville, Ohio plant between 1953 and May 3, 1987.

Cyprus Foote Mineral Company has taken and continues to take steps to investigate and identify properties containing slag received from the Byesville plant in conjunction with the United States Nuclear Regulatory Commission. While it is not anticipated that the levels of radioactivity associated with the slag are such to have caused personal injury, the settlement negotiations will monitor the regulatory process and focus on the identification, investigation and the potential harm that may be associated with remediation and establishment of fund availability for those, if any, that may be injured.

Claims by or on behalf of class members against Defendants other than Cyprus Foote are not part of any settlement negotiations and are not provisionally certified for class action treatment.

HOW YOU ARE AFFECTED

The settlement class contemplated is a mandatory class. If a settlement is reached, and if you fall within the definition of the settlement class, you are automatically a member of the class and subject to the terms of the settlement. All Settlement Class members' interests are represented by The Alexander Law Firm automatically, which has been designated by the Court in its Provisional Certification Order to represent the interests of the settlement class. You may hire another attorney, at your own expense, to intervene or appear on your behalf, but you are not required to hire another attorney.

ATTORNEYS' FEES AND EXPENSES

The Alexander Law Firm will apply to the Court for an award of attorneys' fees from the settlement fund for their services in representing the settlement class. You will not be required to expend your own money either for fees to The Alexander Law Firm or for litigation costs. Any request for reimbursement of out-of-pocket expenses incurred in connection with the settlement must be approved by the Court as fair and reasonable.

EXAMINATION OF PAPERS

1. This Notice contains a summary of the existence of and status of settlement negotiations and is not intended, and should not be construed as, statement of any proposed settlement or admission of liability that you have been harmed or damaged in any manner.

2. For a more detailed statement of the matters involved in the lawsuit, including the claims asserted, you are referred to the papers on file under the *Strawsburg, et al., v. Metallurg, et al.*, Consolidated Case No. C-2-94-1069, which may be inspected during regular business hours at the office of the Clerk of the United States District Court for the Southern District of Ohio, Eastern Division, Columbus, Ohio.

You may also communicate with any of the attorneys listed below; the Clerk's office is not permitted to give legal advice.

THE ALEXANDER LAW FIRM
Richard Alexander
Mark P. Rapazzini
M. Elizabeth Graham
55 S. Market Street, Suite 1080
San Jose, CA 95113
(408) 289-1776
(408) 287-1776 FAX
Lead and Liaison Class Counsel

IT IS SO ORDERED

Dated: 7/10/95

Honorable Nora King, Magistrate Judge

NORAH MCCANN KING,
U.S. MAGISTRATE JUDGE

105
MK
SW
9/22/85

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

FILED
KENNETH J. MURPHY
CLERK

95 SEP 22 PM 4:05

ALLAN STRAWSBURG, et al.,
Plaintiffs,

U.S. DISTRICT COURT
SOUTHERN DIST. OHIO
EAST. DIV. COLUMBUS

vs.

Civil Action 2:94-CV-1069

METALLURG INC., et al.,
Defendants.

ORDER

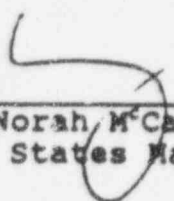
A status conference was held on September 20, 1995.
Counsel for all parties participated.

All parties are in the process of investigating the
dimensions of the provisionally-certified class and the remediation
problem. One hundred eleven (111) properties have been identified
as potentially containing the allegedly radioactive slag; fewer
than 12 of those properties are believed to present major
remediation concerns.

Plaintiffs will provide, no later than October 31, 1995,
their position papers; defendants may have thirty (30) days
thereafter to provide plaintiffs with their own position papers.

The stay previously imposed is ORDERED CONTINUED.

Another status conference will be held in January 1996.



Norah McCann King
United States Magistrate Judge

EXHIBIT 73 6

ULMER & BERNE P.L.L.
ATTORNEYS AT LAW

Internet Address
<http://www.ulmer.com/>

Bond Court Building
1300 East Ninth Street, Suite 900
Cleveland, Ohio 44114-1583
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Columbus Office
88 East Broad Street, Suite 1980
Columbus, Ohio 43215-3506
Fax (614) 228-8561
Telephone (614) 228-8400

STEVEN D. BELL

(216) 621-8400

February 19, 1996

Robert Casarona, Esq.
Climaco, Climaco, Seminatore,
Lefkowitz & Garofoli
The Halle Building, 9th Floor
1228 Euclid Avenue
Cleveland, OH 44115

RE: Malernee Family

Dear Bob:

As we discussed on February 14, 1996, the Malernee family would like to begin discussions to see whether an agreement can be reached which will fully resolve any and all claims which members of the Malernee family may seek to assert against Cyprus Amax.

At the outset, please allow me to indicate that getting the Malernees' claims resolved is a more important objective to me than is the means by which resolution of these claims is described. Thus, within reason, the Malernees are willing to be flexible in terms of the description which may need to be placed on various aspects of their settlement so that Cyprus Amax does not unnecessarily compromise any positions which it has taken (or may wish to take) in the pending litigation.

As we discussed on February 14, there are a variety of options which may be employed to address the conditions now found on the Malernees' property. After discussing this matter with the Malernees at some length, I believe that their preference would be to stay in their present home in its present location if full remediation of the property can be completed by Cyprus Amax and its contractors, and further if the Malernees can be relocated to a suitable location between now and the date when remediation of their property is accomplished. If it is determined that remediation of the Malernee home will cause structural damage to the premises, the Malernees second option is to be able to rebuild their home on their current property after remediation has been completed. Once

EXHIBIT 8

ULMER & BERNE P.L.L.

Robert Casarona, Esq.

February 15, 1996

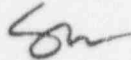
Page 2

again, the Malernees will need to find alternative housing while remediation and reconstruction would be taking place. As a third option, the Malernees would be willing to discuss a sale of their property to Cyprus Amax, and to negotiate an amount of relocation costs. It is the Malernees current preference to find a way to stay in their home.

We have never made any claim that the conditions on the Malernee property are the proximate cause of any of the respiratory ailments currently suffered by the Malernee children. Nonetheless, Ed and Sue Ann are enormously concerned as to whether the radon found in their home may have exacerbated the respiratory problems suffered by their children, and whether the exposure to radon suffered in the past by the children may eventually lead to the development of disease. As we discussed last week, Sue Ann Malernee has been particularly affected by these concerns. Accordingly, we also need to discuss a means by which the Malernees can be compensated for their emotional distress, as well as for their unreimbursed medical/psychological expenses. We also need to discuss establishing a trust for the future evaluation of adverse health effects which may be suffered by members of the family. Again, the Malernees are quite flexible in how these matters may be described in any settlement document.

On behalf of the Malernees, I would be appreciative if you would discuss these matters with Cyprus Amax, and if you would let me know at your earliest convenience whether a meeting to discuss these matters would be productive.

Very truly yours,



Steven D. Bell

145:kmh

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