8005140041
EA252

TESTIMONY ON DECONTAMINATION OF THE THREE-MILE-ISLAND UNIT-2 REACTOR BUILDING'S ATMOSPHERE

TO: The U.S. Nuclear Regulatory Commission (N.R.C.)
1717 H Street, N.W.
Washington, D.C. 20555

FROM: Daniel M. Lipkin, physicist
1717 Bantry Drive (215)-646-7522
Dresher, Pennsylvania 19025

ATT'N: Samuel J. Chilk, Secretary, N.R.C.

DOCKET No.: 50-320 DATE: April 7, 1980

also ATT'N: Director, TMI Support Staff, N.R.C. Office of Nuclear Reactor Regulation (N.R.R.)
Harold R. Denton, Director, N.R.C./N.R.R.
John T. Collins, Jr., Chief, N.R.C./N.R.R. Effluent Treatment Systems Branch
Robert J. Budnitz, Director, N.R.C. Office of Nuclear Regulatory Research
John F. Ahearne, Chairman, N.R.C.
Peter A. Bradford, Commissioner, N.R.C.
Victor Gilinsky, Commissioner, N.R.C.
Joseph M. Hendrie, Commissioner, N.R.C.
Richard T. Kennedy, Commissioner, N.R.C.

other cc: additional distribution as per attached list.

REFERENCE: N.R.C. Document NUREG-0662, "Environmental Assessment for Decontamination of the Three Mile Island Unit 2 Reactor Building Atmosphere". Hyphenated-page locations noted in the text below refer exclusively to that document.

Dear Sirs:

Your referenced document NUREG-0662 indicates great difficulties of four different methods for removing Krypton gas contamination from the TMI Unit-2 Reactor Building, in comparison with the technically simple alternative of venting that gas into the public air space. My testimony will show that one of those four methods, based on the admittedly feasible (page 1-6) use of charcoal to adsorb Krypton gas, has been unimaginatively if not clumsily conceived in both of the versions described (pages 6-9 to 6-16), and should be capable of approximately twenty times greater simplicity if modified in ways that should be obvious to those skilled in the technical arts involved. As a citizen, I am greatly disappointed at this performance of agencies that have been invested with the public trust.

For the purpose of my discussion, and essentially only by way of illustration, I shall take as a goal the reduction of the Krypton concentration in the TMI Unit-2 Reactor Building's Atmosphere (henceforth, "TMI-2" or just plain "R2") to 1/100 of its present value. This does not represent an ultimate limit of relatively simple applications of

the charcoal-adsorber technology involved; and it does not approach the idealized goal of 100,000:1 reduction of the Krypton concentration that is implicitly adopted in NUREG-0662 (data on pages 3-1 or 5-2, plus data on pages 6-2 or 6-28; consistent with data on page 6-13). But a reduction by "merely" 100:1 would provide a useful and practical solution of the Krypton contamination problem: At present, approximately 1/4 of the gamma radiation that would affect workers inside TMI-2 is indicated as being caused by sources other than the Krypton gas (page 4-2); therefore, a 100:1 reduction in the concentration of the Krypton gas would bring its gamma radiation down to a level 33 times smaller than that of the other (and unventable) sources of gamma radiation already in the reactor building, and would thus constitute a quite handsome improvement of the situation.

In a proper use of charcoal adsorber technology, important advantage can and should be taken of the fact (stated on page 6-9 but not exploited in NUREG-0662) that charcoal loses its ability to adsorb Krypton if it is exposed to even moderately small levels of humidity. This fact permits previously adsorbed Krypton to be largely flushed out of a charcoal tank if desired, and thus permits Krypton gas to be transferred between a small number of such tanks in a controlled manner. Such transfers, if programed in a readily understood manner, will in principle permit the available Krypton to be concentrated with a high degree of precision into a single one of the tanks. Proper engineering insight can thus eliminate any need to consider the monstrous scenario of hundreds of charcoal adsorber tanks (page 6-13) that is painted in NUREG-0662.

I shall consider refrigerated charcoal adsorber to be used, maintained at an ordinary food-freezer temperature of 0 °F. (page 6-11) whenever it is in the process of being used to adsorb Krypton from suitably conditioned air (completely dehumidified and dried air -- pages 6-9, 6-10). In that context, the charcoal adsorber scheme described in NUREG-0662 is stated to require the use of 150 charcoal-containing tanks (page 6-13), each of volume 42,300. gallons (implied on page 6-10). This number, 150, of such tanks does not, however, serve as a fair basis for comparison, because it corresponds to much more than the targeted 100:1 reduction in the Krypton concentration in R2. It can readily be shown that 59 or 60 of such tanks would, however, be needed for a 100:1 reduction of the Krypton concentration by the refrigerated-charcoal adsorber method described in NUREG-0662, and this does provide a fair starting figure on which to base comparisons. By contrast with this last, approximate figure of 59 or 60 tanks of charcoal, the method that I shall describe requires the use of only 3 separate tanks of charcoal of the individual size indicated, and therefore presents a dramatically different picture as regards practicality.

Consider there to be provided three separate bodies of charcoal adsorber, each having the single-tank volume already indicated, and designate them as L, M, and N for brevity. A Krypton "transfer" cycle, utilizing two of these three charcoal bodies, is executed in three steps, as follows:

(a) Filtered, dried, and heated air from the reactor building R2 is circulated through the first charcoal body, L, and returned to R2 in a closed circuit of air flow, as a preparatory step,

to remove any moisture that the body L may contain. (Both in this step and in the step (b) that follows, a net preponderance of cooling would be applied to the air returning to R2, to avoid any rise of the air pressure inside R2, and indeed to forestall or compensate such a rise of pressure due to any outside causes.)

(b) When L is dry, the closed-circuit flow of air between R2 and L is continued, but now the filtered and dried air entering L is not heated, but instead is refrigerated to 0 °F., to cool L down to that temperature and permit it to adsorb Krypton gas maximally well (page 6-10) from the R2 air flowing through it.

(c) When L has come to equilibrium in its Krypton content and will adsorb no further Krypton (i.e., when "breakthrough" occurs -- page 6-10), valves are operated to disconnect L from R2 and to connect L instead to the second charcoal body, M, which has previously been dried and refrigerated to 0 °F. Closed-circuit air flow is now established between the two charcoal bodies L and M, with the following special provisions:

c.1. The air that is to enter M is first dried and refrigerated, to maintain M at 0 °F. and permit it to adsorb Krypton maximally well. (No moisture, or heat, are introduced into M during any part of a transfer cycle.)

c.2. The air tnat is to reenter L is heated and humidified, to cause L to lose its ability to adsorb Krypton (page 6-9), and thus in effect to flush out nearly all of its adsorbed Krypton into the circulated air, from whence the Krypton is available to be adsorbed by M.

In the course of effectuating the provisions c.1. and c.2., the heat and the moisture that are removed as waste from the circulated air before it is allowed to enter charcoal body M are shunted back usefully to aid the process of heating and humidifying the air entering L. The combined process c.1.,c.2. causes the Krypton initially present in the charcoal bodies L and M to become preponderantly concentrated into M, and largely removed from L; this process is allowed to run to completion as measured by stabilization of the Krypton-85 radioactivity levels in the respective bodies L and M, after which the communication between L and M by air flow is disconnected.

Repetition of the transfer cycle (a)-(b)-(c) continually transfers Krypton from R2 to L, and then from L to M as a temporary receiver, leaving the charcoal body L depleted in its Krypton content at the end of each transfer cycle and therefore able to adsorb more Krypton from R2 during the next such cycle.

By using available information concerning the initial Krypton-85 radioactivity in R2 (pages 3-1, 6-37, 6-5, 5-2), and concerning the amount of this radioactivity that can be adsorbed into a first tank of refrigerated charcoal adsorber (page 6-13), and by further assuming

cess drives most of the Krypton out of M and concentrates it into N, and is continued until it reaches completion. (At this point, the charcoal body M contains moisture, which must be removed before M can resume participation in transfer cycles.)

(e) The charcoal bodies L and M are next placed into closed-circuit circulated-air communication with one another, and heated air is circulated through both of them, the circulated air being, however, dried before entering M (moisture that is removed as waste from the air stream before it enters M is shunted back to L). This process dries any moisture out of M, and traps the moisture in L.

(f) After M is dry, the closed-circuit circulation of air between L and M is continued, but the air is now both dried and refrigerated before it enters M, and is heated and humidified before it reenters L, just as in step (c) of a transfer cycle. This ensures that most of the residual Krypton in L and M will be concentrated into M, and completes the reconditioning of M to a dry, cold state suitable for use in a resumption of the transfer-cycling (a)-(b)-(c).

If the processes of transfer-cycling and of storage-cycling, that have been described as a means for extracting Krypton from the building R2, seem complicated, it is only because I have attempted some precision in describing them: they are actually quite simple from a technical standpoint. Thus, the combined total volume occupied by the charcoal in all three of the adsorbing bodies, which is about 17,000 cubic feet, is only the air volume in a medium-to-large-size private home. The physical operations that are essential to the decontamination process under discussion are only the heating of air, the cooling of air, the humidification of air, the dehumidification and drying of air, and the forced circulation of air, all of which are common technology. As to forced flow of air out of the building R2 for the described purpose of closed-cycle circulation, a flow rate of 1000 cubic feet per minute (CFM) of filtered air represents a capability that is already (page 6-1) being installed at TMI-2 as part of the proposed "purge" system for venting the Krypton. Although an air flow rate of 1000 CFM represents less than what is commonly used in single-home central air-conditioning, it is still adequate to move 2,000,000 cubic feet of air (one reactor building's content) five times in a week -- and to change the air in one of the charcoal adsorber bodies under discussion more than 10 times in an hour. Because the Krypton decontamination process under discussion involves rather large and abrupt temperature changes of circulated air, the heat or cold supply rates that are involved do need to be much larger than those involved in single-home central air-conditioning; but the supply rates can be minimized by using well known counter-flow heat-exchange techniques affecting waste heat or cold, and, at any event, should not prove larger than those required for, say, a supermarket (if indeed suitable facilities do not already exist in some unrecognized form at the site).

With the immediately preceding discussion of air flow rates and the like, as background for a preliminary understanding of the degree of difficulty or simplicity of the Krypton decontamination method I have described, the performance that can be expected for that method

is described, and conservatively described, I believe, by the numbers given in the accompanying Table 1. In Table 1, the first column counts the process cycles that are gone through; the second column tells the type of each process cycle; and the remaining four columns predict the amounts of Krypton that will exist in the reactor building R2 and in the three charcoal adsorber bodies L, M, N at the end of each cycle; those Krypton amounts are expressed to three significant figures, as decimal fractions of the total amount of Krypton initially located in the reactor building.

As is shown by the third column of Table 1, on line 77, the Krypton concentration in the reactor building R2 should be down to below 1% of its initial value, after 77 cycles have been performed. At a processing rate of perhaps four cycles per day, the entire Krypton decontamination of R2 could therefore take less than 3 weeks from start to finish.

In discussing the foregoing example of a practical Krypton decontamination method, it is not my intention to suggest, as NUREG-0662 does (pages 6-9 through 6-14), that the charcoal adsorber tanks be used for permanent storage of the Krypton removed from the reactor building. Instead, the adsorbers should only be regarded as a temporary storage means for the Krypton, until such time that it can be dealt with by methods permitting its greater concentration for final disposal by burial, but requiring longer times to implement (e.g., pages 6-23, 6-32). This provision of temporary storage would suffice to accomplish the primary public-safety goal of permitting expeditious access to the damaged #2 reactor core for the purpose of safe disassembly of that core; and it would do so without risking the public distress (pages 1-3, 6-7) that might attend venting of the Krypton gas.

I hope that the discussion and analysis presented here may straighten out the perspective from which the Krypton decontamination problem is viewed, and prove useful in expediting an acceptable solution to that problem.

Sincerely yours,

Daniel M. Lipkin, physicist

TABLE 1: Estimated Progress of the Krypton Decontamination

Ordinal No. of Process Cycle	Type of Process Cycle (see text)	Fractional Krypton Amounts at End of Cycle in Reactor Building, "R2"	in First Charcoal Body, "L"	in Second Charcoal Body, "M"	in Third Charcoal Body, "N"
0	(initial state)	1.000	0.000	0.000	0.000
1	transfer	0.925	0.00129	0.0742	0.000
2	transfer	0.856	0.00245	0.142	0.000
3	transfer	0.794	0.00351	0.203	0.000
4	transfer	0.737	0.00448	0.258	0.000
5	transfer	0.686	0.00536	0.309	0.000
6	transfer	0.639	0.00615	0.355	0.000
7	transfer	0.596	0.00688	0.397	0.000
8	transfer	0.558	0.00753	0.435	0.000
9	transfer	0.523	0.00813	0.469	0.000
10	storage	0.523	0.000275	0.0158	0.461
11	transfer	0.483	0.000942	0.0544	0.461
12	transfer	0.448	0.00155	0.0893	0.461
13	transfer	0.415	0.00210	0.121	0.461
14	transfer	0.386	0.00260	0.150	0.461
15	transfer	0.359	0.00306	0.176	0.461
16	transfer	0.335	0.00347	0.200	0.461
17	transfer	0.313	0.00384	0.222	0.461
18	transfer	0.293	0.00419	0.242	0.461
19	transfer	0.275	0.00450	0.260	0.461
20	storage	0.275	0.000286	0.0165	0.709
21	transfer	0.254	0.000634	0.0366	0.709
22	transfer	0.236	0.000951	0.0549	0.709
23	transfer	0.219	0.00124	0.0715	0.709
.	.	.	.	.	.
.	.	.	.	.	.
.	. (etc.)	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
68	transfer	0.0149	0.000445	0.0257	0.959
69	transfer	0.0141	0.000457	0.0264	0.959
70	storage	0.0141	0.000294	0.0169	0.969
71	transfer	0.0134	0.000307	0.0177	0.969
72	transfer	0.0126	0.000319	0.0184	0.969
73	transfer	0.0120	0.000331	0.0191	0.969
74	transfer	0.0114	0.000341	0.0197	0.969
75	transfer	0.0108	0.000350	0.0202	0.969
76	transfer	0.0103	0.000358	0.0207	0.969
** 77	transfer	0.00989	0.000366	0.0211	0.969
78	transfer	0.00948	0.000373	0.0215	0.969
79	transfer	0.00911	0.000379	0.0219	0.969
80	storage	0.00911	0.000294	0.0170	0.974
81	transfer	0.00869	0.000301	0.0174	0.974
82	transfer	0.00832	0.000307	0.0177	0.974
83	transfer	0.00797	0.000313	0.0181	0.974

Distribution List

The Hon. Richard L. Thornburgh, Governor
Commonwealth of Pennsylvania
Main Capitol Building
Harrisburg, Pennsylvania 17120

Dr. Robert D. Pollard
Union of Concerned Scientists
1725 I Street, N.W.- Suite 601
Washington, D.C. 20006

Dr. Henry W. Kendall
Union of Concerned Scientists
1208 Massachusetts Avenue
Cambridge, Massachusetts 02138

Jack H. Watson, Jr., Cab.Sec'y.
The White House Office
1600 Pennsylvania Avenue, N.W.
Washington, D.C. 20500

Charles Warren, Chairman
Council on Environmental Quality
722 Jackson Place, N.W.
Washington, D.C. 20006

National Commission on Air Quality
499 S. Capitol Street, S.W.
Washington, D.C. 20003

President, Metropolitan Edison Co.
P.O. Box 542
Reading, Pennsylvania 19640

Douglas M. Costle, Administrator
U.S. Environmental Protection Agency -- A-100
401 M Street, S.W.
Washington, D.C. 20460

David Hawkins, Ass't. Admin./A,N,R.
U. S. E. P. A.
401 M Street, S.W.
Washington, D.C. 20460

John Russell, Chief
En.& Fac. Eval. Br., O.R.P.
U.S. E.P.A. - ANR 459
Washington, D.C. 20460

U.S. Senator John Heinz
4327 Dirksen Senate Office Bldg.
Washington, D.C. 20510

U.S. Senator Richard S. Schweiker
253 Russell Senate Office Building
Washington, D.C. 20510

U.S. Repr. Lawrence Coughlin
306 Cannon Office Building
Washington, D.C. 20515

State Senator Stewart J. Greenleaf
306 Wyncote Road
Jenkintown, Pennsylvania 19046

State Representative Vern Pyles
3239 Pebblewood Lane
Dresher, Pennsylvania 19025

Lawrence H. Curry,
Montgomery County Commissioner
Courthouse, Norristown, PA 19404

Louise Bradford, Staff
Three-Mile-Island ALERT
315 Peffer Street
Harrisburg, Pennsylvania 17102

Gail Bradford, Staff
March 28th Coalition
1037 Maclay Street
Harrisburg, Pennsylvania 17103

Lt. Gen. John W. Morris
Chief of Engineers
The Pentagon
Washington, D.C. 20310

Prof. Ernest J. Sternglass
Rm. RC 406, Scaife Hall, Radiation Center
University of Pittsburgh
Pittsburgh, Pennsylvania 15261