NOV 2 6 1962

Mr. James E. Beal, Jr.
Executive Director
Office of Coordinator of Atomic Activities
Commonwealth of Kentucky
Frankfort, Kentucky

Dear Mr. Beal:

This refers to your letter of November 2, 1962 to Mr. Lowenstein and the enclosed documents concerning the application and license for Nuclear Engineering Company's waste disposal activity to be conducted near Morehead, Kentucky.

The "Geologic and Hydrologic Evaluation of a Proposed Site for Burial of Solid Radioactive Wastes Northwest of Morehead, Fleming County, Kentucky by Ian R. Walker, Geologist, New Jersey Geological Survey," which was included as part of Nuclear Engineering's application, was discussed at length by Mr. Weaver and Mr. Bernard, as you will recall, at our meeting in Frankfort last September 26. It was agreed during that discussion that firm conclusions could not be drawn, on the basis of information contained in the report, concerning the geologic suitability of the proposed burial site to assure that there would not be transport of radioactive materials through ground water to surrounding wells and streams. Mr. Weaver indicated that he would obtain additional information bearing upon the questions identified. In the circumstances, we had assumed that no further comments would be expected from the AEC staff until such information had been received. If it is now available and you wish us to comment on it, we would be glad to do so. Also, if the Health Department staff has prepared an analysis of this proposed operation, such as the one we sent you concerning the Beatty, Nevada operation, this would be helpful in making such a review.

We do note several points, however, in Nuclear Engineering's application and license concerning handling and monitoring techniques about which we have some thoughts. Nuclear Engineering does not propose to back fill a trench until it is full of packages.

It would be desirable, we believe, that back filling be done on a frequent, preferably daily, basis. A delayed back fill may be particularly undesirable with radioactivity packaged in fiber board or wooden containers because of deterioration of containers, release to rain and surface water of radioactivity and airborne hazards associated with materials from ruptured or deteriorated packages.

License Condition 15 would require the licensee to mound earth over a burial trench upon completion of a burial operation. We suggest that you consider whether there should not also be a requirement to maintain the mounding if the surface sinks due to compacting of the fill or the collapsing of containers in the trench.

License Condition 16 requires the licensee to perform further surveys and isotopic analyses if water samples from the test holes located on-site or from wells and streams located off-site reveal a beta concentration greater than 10^{-6} uc/cc or alpha concentration greater than 10^{-7} uc/cc. The permissible concentration in water above natural background permitted by Kentucky regulation RR-4 for unrestricted areas is 10^{-5} uc/cc for unidentified radionuclides and 10^{-7} uc/cc if it is known that radium 226 and 228 are not present. Additional determinations must be made concerning the origin of the radioactivity if the concentrations specified in this condition are exceeded. Therefore, we believe that the concentrations at which such further determinations are to be made should be as low as can reasonably be detected rather than at levels which are a factor of 10 higher than permitted by Kentucky (and AEC) regulations, in order that loss of radioactivity from the burial site would be determined as soon as possible. Presumably, if radioactivity originating from buried wastes is found in off-site streams, remedial action will be taken. We note, however, that Nuclear Engineering's application does not propose any specific course of action in this regard. Since long-lived material will be permanently buried, we suggest that the possible courses of remedial action be considered before operations begin.

Section VI, Appendix B, Paragraph 2, of Nuclear Engineering's application indicates that the bottom of each burial trench will be provided with an approximate 1% slope, a covering of creek gravel of similar material to provide a drainage bed, and a pipe in a sump pit to enable sampling and removal of water entering the pit. Since, if radioactivity is present in such water, there may be long term need for pumping from the pits and processing the water, we would be interested in learning of the proposed procedures for such sampling, pumping and processing. Questions might also be raised as to the criteria for determining whether a fracture requires grouting, the type of grout to be used, and any tests of the effectiveness of the seal.

We appreciate your interest in sending this application to us and hope that our comments will be helpful. If Mr. Weaver believes that a further conference for the purpose of discussing this program would be desirable, we would be pleased to have appropriate AEC staff members participate.

Sincerely yours,

Original signed by
Forrest Western

Forrest Western, Director
Division of Radiation Protection
Standards

DLR	DLR	DRD	RPS
JRtascu:pvp	ERPrice	Bernard	
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December 7, 1962

Forrest Western, Director
Division of Radiation Protection
Standards
U. S. Atomic Energy Commission
Washington [illegible], D. C.

Dear Mr. Western:

Your letter of November [illegible], regarding the Nuclear Engineering Company's proposed waste disposal license, has been received. We were particularly pleased with the careful review which your office has given this subject as we feel that a State issuing a license of this type for the first time must be extremely careful because of the precedent being established. The advice and consultation given by several of the U. S. Atomic Energy Commission offices, the U. S. Public Health Service, the U. S. Geological Survey, and several Kentucky State offices, have been of great value to us.

Several points which you mentioned in the above referenced letter were indeed the subject of discussion in the various meetings which were held for the purpose of evaluating the license application and determining if all our radiation safety criteria had been met. While you may not be fully aware of it, we want to assure your office that we held a series of conferences on this matter to discuss the proposed facility and its operating procedures. The Division of Environmental Health, formerly a Bureau, held the last major staff conference on this license application just prior to issuance of a license. Among those represented were:

(1) Radiological Health;
(2) Engineering, which represented the public water supply interests;
(3) Sanitation, which represented the private water supply interests;
(4) Water Pollution Control Commission, which represented water conservation and pollution interests; and
(5) Occupational Health, which represented the health of workers and air pollution aspects.

Our decision to issue Nuclear Engineering Company a license was not based upon a formal written staff analysis such as your Docket No. 27-10 for the Beatty, Nevada, site. However, material similar to that presented in the AEC Staff Paper was utilized in our meetings and conferences and in our discussions which formed the basis of the licensing analysis.

In regard to the backfilling operation, you will note that in Section VI, Appendix D, paragraph 3 of the application and in recognition of the fact that the annual rainfall is approximately 4½ inches, it stated that drainage ditches must be constructed around the trenches to divert rainwater and the trenches will be kept covered to prevent direct entry of rainwater until such time as they are backfilled. We feel that this provides adequate protection for those packages subject to deterioration by the elements and permits a neater operation than would be the case with a partially backfilled and partially covered trench. The plan of operation in this instance provides for an overlap cover for the complete length of the excavated trench regardless of its length. Therefore, the stored material will be under cover at all times prior to the backfilling operation. Your suggestion concerning the mounding of the trench as compacting occurs during the ensuing months is well taken. Nuclear Engineering Company has informed us that they agree with this recommendation and will incorporate it in their operating procedures.

Even though license Condition 16 contains a specific number for gross alpha and gross beta concentrations, it does not mean that the data obtained from the analyses of water for gross alpha and beta activity will be ignored unless the concentration exceeds the specified level. Routine samples of water will be obtained by the Health Department for analysis and will be from the same selected locations as Nuclear Engineering Company's. It is intended that the majority of these samples will be taken concurrently by both groups. In view of the fact that the water background data from the site area was limited to two sets of monthly samples, we do not feel justified in using an increase over background as the criteria at this time. Therefore, a number was selected which was a factor of 10 higher than that permitted by the Kentucky radiological health regulations. It is possible that this license Condition should be amended to provide for a lower concentration should it be determined, based on actual water analysis data, that the present concentration is too high.

Nuclear Engineering Company's application did not specify remedial action which would be taken should radioactivity be found in the off-site streams as a result of their burial operations. However, in our discussions at the Health Department, various operational techniques were discussed and it was determined that definitive plans could not be formulated at this time since the corrective action taken would be determined by the conditions which brought about the transport of the material. Several technically feasible procedures were postulated and it was decided that adequate protection of the public could be provided by

any of the several proposed methods.

With reference to Section 6, Appendix D, paragraph 2 of Nuclear Engineering Company's application, it is our opinion that the licensee should only be responsible for providing this office with a statement of intent that they will:

(1) Provide a sump at the end of each trench;
(2) Sample the water at frequent intervals; and
(3) Process the water by solidification.

The engineering details on the specific methods which will accomplish these objectives will be worked out by the licensee based on operational experience. In reaching this conclusion, recognition was made of the fact that a representative of the Health Department would be present at all burial operations and in addition, due to close proximity to this office, frequent visits would be made to the burial site to observe the licensee's operations. Nuclear Engineering Company has informed us they recognize that tests will be required at each burial trench to determine the effectiveness of grouting fractures. We are confident that this operational procedure will effectively confine any contamination leached from the buried material to the burial trench.

In closing, let me repeat that we are most grateful for the assistance which your agency has provided by reviewing this license application. I am sure that as the burial pits are excavated and operations begin, more specific operational details will develop. We would be happy to have appropriate members of your staff visit this facility for an on-site inspection at any time subsequent to commencement of burial operations.

Sincerely yours,

Russell E. Teague, M. D.
Commissioner of Health

CLW:gpl

CC: Ralph C. Pickard

CC: James N. Neel, Jr.

CC: Richard Mayhew

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December 13, 1962

James H. Neel, Jr., Executive Director
Kentucky Atomic Energy Authority
Plaza Professional Building
Leawood Avenue
Frankfort, Kentucky

Dear Jim:

As requested at the meeting on December 10, the following information is furnished on the hazard analysis of maximum creditable accident at the Nuclear Service Facility at Maxey Flats, Kentucky. This analysis is directed toward determining the possible mechanisms by which radioactive contamination would leave the burial site and become a health hazard to people in the areas adjoining the burial site. The analysis is concerned with two primary mechanisms of transport which could result in air-borne and ground water contamination.

Air-Borne Contamination

It is very difficult to conceive the conditions which would have to exist at a low level burial site which would create an explosion with sufficient heat (equivalent to the detonation of approximately one ton of TNT) to vaporize the buried material to the extent that a cloud would form and rise to sufficient height so that the surface winds could transport the radioactive material downwind sufficient distance to become a health hazard to off-site people. Notwithstanding the lack of knowledge of how it will occur, I have assumed under a maximum creditable accident criterion that 100 curies of fission products could be volatized and, by air transport under a temperature inversion condition, evenly distributed over an area of 0.35 square mile. From weapons test data we know that 10^3 curies of fresh fission products distributed over one square mile will produce a gamma dose rate of 4.1 roentgen per hour measured three feet above the ground. Since the products we are considering are not fresh fission products, the estimate in this case is on the conservative side. Assuming that the ground dose rate scales directly with the curies of activity evenly distributed, the gamma field is reduced by the ratio of the degree of the activity from 10^3 curies to 10^2 or by a factor of 10^1. Using this factor we would then arrive at a dose rate of 0.41 milliroentgen per hour per square mile or 1.2

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millirocntgen per hour per 0.35 square mile. A more restrictive case would distribute 100 curies over 0.1 square mile and would produce a dose rate of 4.1 millirocntgens per hour.

An estimate of the potential loss arising from contamination of land to the degree stated above, i.e., 0.41 millirocntgen per hour, is dependent upon three factors:

(1.) Evacuation of personnel in an orderly manner,
(2) Restriction on use of land and outdoor activity, and
(3) Crop and farm restriction which does not apply in this case.

Since we have no experience factor upon which to estimate the cost which may be reasonably expected under each of the first two conditions, I have used the cost prepared by the Atomic Energy Commission in evaluating the cost resulting from contamination from a reactor accident. The following is an estimate of these costs:

(1) Evacuation of Personnel - $5000 per person
(2) Restriction on Land Activity - $750 per person

Under the conditions which we have assumed and under the dose rate calculated for the maximum creditable accident, it does not appear probable that any personal injury would be likely. The estimated damage that could be caused in this instance would be due entirely to evacuation costs and payments for denial of the use of land. The range of costs and payments have been covered in the above discussion. From a map survey of the potential contamination areas and using our knowledge of the population density of the area, it is estimated that the maximum number of families who could be involved is ten.

Ground Water Contamination

A maximum creditable accident that might occur which would cause us the greatest concern would be the contamination of the ground water in the immediate vicinity of the land burial site. In order to arrive at an estimate of the degree of contamination involved, I have assumed a maximum of 750 curies of low-level waste would be buried in the course of one year of operation. This figure is obtained from the Atomic Energy Commission and uses the experience factor and estimated growth of the Oak Ridge burial site. The maximum creditable accident that could reasonably be expected to occur would result from the loss over a period of one year of 50 per cent of the radioactivity from the burial pits and a further 25 per cent loss of activity during the movement of the radioactive particles through the interstices and bedding plains. The radioactive material would have to move a minimum distance of 2,000 feet to reach the tributary stream to Rock Lick Creek and approximately the same distance to the nearest spring. The stream flow

records of the U. S. Geological Survey Gauging Station on Licking River at Farmers, Rowan County, approximately eight miles south of Maxey Flats, show that the discharge is equal to or greater than 0.7 cubic foot per second 99 per cent of the time. It is estimated that there is flow in the lower reaches of the small tributary draining the Maxey Flats area 90 per cent of the time.

The 760 curies of activity reduced by 75 per cent gives a value of 190 curies which can be converted to a constant daily return into the stream over a period of one year. Therefore, 0.52 curie per day would reach the stream and would be diluted with 60,480 cubic feet per day (0.7 cfs) of water flowing in the stream. The resultant stream concentration at the point of entry would be approximately 3×10^{-4} microcuries per cubic centimeter. This concentration is a factor of 10^{2} higher than the concentration which is permitted under Kentucky radiological health regulations and the drinking water standards if Strontium-90 is known not to be present. As the water moves through the tributaries to Rock Lick Creek further dilution will occur and it is obvious that by the time it is diluted with the water in Rock Lick Creek that the concentration will be less than that acceptable by our regulations. In addition according to the Health Department Engineering and Water Pollution records, the nearest community using water from this drainage basin is 70 miles from the burial site.

The contamination problem which would result if this same concentration were to reach the springs or other source of drinking water for any farmer immediately adjacent to the burial site is much more difficult to estimate. We have no data on which to base the dilution of the radioactivity prior to reaching the springs from an underground source of water. Therefore, we must assume under the maximum creditable accident criterion that the spring water would have a concentration greater than that permitted under our "RH" regulations.

An estimate of the cost involved in this instance would be that required to provide drinking water to the maximum number of families that could possibly be affected by contamination of their water supply through this mechanism. A maximum of five families could be affected and would require remedial action. There are two possible solutions to the drinking water problem:

(1) Provide drinking water by hauling from Morehead or Flemingsburg; or
(2) Provide each family with a pump and an ion exchange system.

The estimated cost for each of these two methods is as follows:

(1) Hauling water - $50 per month per family
(2) Ion exchange system - $1000 for initial equipment cost and $25 per month operating cost per family

We trust the above information is a satisfactory analysis of the radiation contamination problem which could develop as a result of a single maximum creditable accident resulting from operations at the Nuclear Engineering Company burial site at Maxey Flats. I would like to emphasize that the data and figures presented herein are estimates only and were developed from a hypothetical situation which I do not believe could occur as a result of the operations of the burial site as we foresee them today.

Sincerely yours,

Charles L. Weaver
Director of Radiological Health

CLW:gpl