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April 7, 1999
'99 APR -8 P4:18

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD PANEL

OFFICE OF SECRETARY
RULEMAKING AND
ADJUDICATIONS STAFF

Before Administrative Judge Peter B. Bloch

In the Matter of)
)
HYDRO RESOURCES, INC.)
2929 Coors Road Suite 101)
Albuquerque, NM 87120)
)

Docket No. 40-8968-ML
ASLBP No. 95-706-01-ML

ENDAUM'S AND SRIC'S RESPONSE TO LBP-99-15,
QUESTIONS CONCERNING RADIOACTIVE AIR EMISSIONS

Eastern Navajo Diné Against Uranium Mining ("ENDAUM") and Southwest Research and Information Center ("SRIC") hereby respectfully submit their responses to the questions posed by LBP-99-15, Memorandum and Order (Questions Concerning Radioactive Air Emissions) (March 18, 1999). This brief is accompanied and supported by the Declaration of Bernd Franke ("Franke Declaration"), attached as Exhibit A, and the Affidavit of Dr. Richard J. Abitz ("Abitz Affidavit"), attached as Exhibit B.

1. *Based on empirical evidence and analysis, what portion of the total effective dose equivalent (TEDE) from the Churchrock site should not be considered to be background radiation either because it is from source material or from byproduct material?*

A. **Legal Analysis.** The answer to this question must begin with a legal analysis of the difference between background radiation and radiation that is included in the TEDE. LBP-99-15 states that 10 C.F.R. § 20.1301 places a limit on the TEDE which

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explicitly excludes certain types of dose, such as background radiation.¹ LBP-99-15 at 6. LBP-99-15 correctly observes that "if the source of a dose is not *excluded* then it is included in the total effective dose equivalent from licensed operations, for the purpose of complying with 10 C.F.R. §§ 20.1301 and 20.1302." Id.

Background radiation is defined in Part 20 as:

radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

10 C.F.R. § 20.1003. As discussed in the Franke Declaration at 2-7, background radiation does not include doses from source and byproduct material on the HRI site, doses from source and byproduct material at other NRC licensed facilities, or doses from source and byproduct material at neighboring mines and mills which are not licensed by the NRC.

As noted in LBP-99-15, the NRC argues that the licensee is not responsible for sources beyond the licensee's control. LBP-99-15 at 4. HRI also makes the same argument. HRI Response at 7. These arguments ignore the plain language of the regulation, which excludes from the definition of background "decay product of source or

¹ Radiation generated by medical procedures and sanitary sewers is also excluded from the calculation of TEDE. 10 C.F.R. § 1301(a)(1); 20.1003 (public dose definition). However, these sources are not relevant here.

special nuclear material." Moreover, the words "not under the control of the licensee" in the second sentence of the definition modify only the phrase "and global fallout as it exists from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation." As discussed in more detail in the Intervenor's Brief at 6-9, the definition of background radiation does not include anthropogenic sources of radiation, with the exception of global fallout.

In addition, as Mr. Franke observes in his Declaration, the result of HRI's and the Staff's interpretation of the regulations would be to allow new licensed operations to create situations in which members of the public would be exposed to radiation levels in excess of the TEDE. Franke Declaration at 5-7. Such a result would be completely at odds with the purpose of 10 C.F.R. Part 20, which is:

to control the receipt, possession, use, transfer, and disposal of licensed material by an licensee in such a manner that the total dose to an individual **(including exposures to licensed and unlicensed radioactive material and from radiation sources other than background radiation)** does not exceed the standards for protection against radiation prescribed in the regulations in this part.

10 C.F.R. § 20.1001(b) (emphasis added). It would also be at odds with later pronouncements by the Commission which further clarify the meaning and intent of Part 20. For instance, in promulgating emissions limits for termination of nuclear facilities, the Commission interpreted the annual public dose limit in 10 C.F.R. Part 20 to apply to multiple doses stemming from all anthropogenic sources. In responding to comments on the proposed rule, the Commission stated:

In response, and by way of background, it is noted that the NCRP [National Council on Radiation Protection and Measurements] in its publication No. 116 (Chapter 15) recommends that, for continuous exposure, the effective dose to members of the public not exceed 1 mSv/y (100 mrem/y) **from all man-made sources, other than medical and not including natural background sources.** Similarly, ICRP, [International Commission on Radiation Protection] in Table 6 of ICRP Publication 60, recommends a limit of 1 mSv/y (100 mrem/y) as the dose limit for the public, and recommendation No. 3 of the draft EPA Federal Radiation Protection Guidance (FRG) indicates that the combined radiation doses incurred in any single year **from all sources** of exposure (excluding medical and natural background) should not normally exceed 1 mSv/y (100 mrem/y) and that continued or chronic exposure of an individual over substantial portions of a lifetime at or near 1 mSv/y (100 mrem/y) should be avoided. **Consistent with these bodies, the NRC issued 10 CFR part 20 (56FR 23360) in 1991 that established a public dose limit of 1 mSv/y (100 mrem/y) in 10 CFR 20.1301.**

NRC Radiological Criteria for License Termination, 62 Fed. Reg. 39058, 39062 (July 21, 1997) (emphasis added). Citing NRC No. 116, Chapter 15 and ICRP 60, Section 5.5.1, the Commission also concluded that:

although the limit for the public dose should be 1 mSv/y (100 mrem/y) **from all man-made sources combined**, it would seem appropriate that the amount that a person would receive from a single source should be further reduced to be a fraction of the limit to account for the possibility that an individual may be exposed to more than one source of man-made radioactivity, thus limiting the potential that an individual would receive a dose at the public dose limit.

Id. (emphasis added). In the same rulemaking, the Commission evaluated the likelihood that individuals could be exposed to “multiple sources with cumulative doses approaching 1 mSv/y (100 mrem/yr),” and considered the possibility that an individual could receive levels approaching constraint levels from “more than one licensed or decommissioned source” *and* “likely radiation exposures to the public from consumer products, air emissions, and fuel cycle facilities (including nuclear power plants)”. Id. at

39063-39064. Accordingly, the NRC adopted a final rule for decommissioning of licensed facilities that is a fraction of the 100 mrem/y public dose limit. Id.

The Commission also clarified its interpretation of Part 20 in a recent proposed rule regarding standards for the proposed high level radioactive waste repository at Yucca Mountain, Nevada. Proposed Rule, Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada, Part II, 64 Fed.Reg. 8640, 8652 (February 22, 1999) ("Proposed Rule for Yucca Mountain"). In proposing a 25 mrem/y limit for any real person beyond the site boundary, and a 25 mrem/y limit for decommissioning, the Commission described Part 20 as requiring:

doses to members of the general public to not exceed a [TEDE] 1 mSv (100 mrem) per year exclusive of the dose contribution from background radiation, medical procedures, and sanitary sewage disposals.

Id. at 8644. In support of the proposed 25 mrem/y standard, the Commission explained that:

International guidance on dose limits suggests establishing constraint limits for specific sources (such as a HLW repository) to ensure that exposure to members of the public **from all sources**, excluding background radiation, is less than the public dose limit.

Id. (emphasis added). Thus, HRI's and the Staff's position that radiation contamination from previous uranium mining cannot be included in evaluating TEDE for the project is entirely inconsistent with the Commission's interpretation of Part 20. The Part 20 annual dose limit of 100 mrem/yr (1 Sv/yr) is designed to protect the public from multiple doses. In the instances where the NRC has analyzed single sources, such as Yucca Mountain and

the license termination rulemaking described above, the NRC has set single source limits much lower than the 100 mrem/y public dose.

Moreover, the 100 mrem/y limit does not present a widespread problem for licensees. The license termination rulemaking notes that it is unlikely that the 100 mrem/yr dose would be exceeded by multiple sources encountered by the public. 62 Fed.Reg. 39063-39064. Church Rock is one of the few unfortunate places in the United States that has been subject to repeated uranium mining and milling operations, most of which were unregulated in the early years of the industry. Thus, the specter raised by Mr. McKenney, that "if licensees had the responsibility to modify their effluents based on the action of other sources nearby, licensees could violate a license condition or the dose limit in Part 20 without releasing anything," aside from its questionable logic, would have little or no application. What is logical, and has been made quite clear by the Commission, is that a new source of radiation may not be permitted to cause radiation doses to the public which exceed the TEDE in Part 20.

B. Technical Analysis. As discussed in the Franke Declaration at 2-4, the total dose at the Church Rock site (T) can be expressed as A (dose from natural background) plus B (dose from ISL operations) plus C (dose from existing source and byproduct materials at the HRI site) plus D (dose from other source and byproduct materials not located on the HRI property but regulated by the NRC) plus E (doses from other source and byproduct materials affecting the area that are not regulated by the NRC). The

TEDE, or annual public dose regulated by Part 20, consists of T minus A. Id. at 3.

There are two possible methods to screen background, either by using surrogate data or identifying and quantifying all non-background contributions and subtracting them from measurements of existing radiation exposures. Id. at 8. Because pre-mining data for the Church Rock site is unavailable, Mr. Franke used surrogate data to determine the level of background radiation at the site. His methods are described in his Declaration at 9-13.

Mr. Franke concludes that "at least half, and as much as 90 percent, of the observed ambient radon concentrations measured in and around the HRI Church Rock mining site since 1980 are from source, byproduct and technologically enhanced (i.e. anthropogenic) radioactive materials." Id. at 2. Mr. Franke calculates, based on the only available data (1987), that natural gamma radiation is 10 to 15 uR/hr, while gamma levels above background are equivalent to about 300-350 mrem/yr. Id. at 9-10. Mr. Franke allows for three possible surrogates for a measurement of natural radon at Church Rock. Id. at 11-14. Data from other nearby locations suggest lower background levels, but Mr. Franke conservatively allows for 1.0 pCi/l of non-background radiation (50 mrem/y). Id.

As Mr. Franke discusses, the method proposed by HRI for determining background levels, which is simply to measure the existing radiation prior to start-up, is inappropriate because mining activities involving the release of radioactive materials had already occurred when the measurements were taken. Franke Declaration at 8-9, 11. Radiation measurements do not exist from the period before uranium mining began in

Church Rock. The scenarios posed by HRI for a higher background level are also unsubstantiated. HRI's remediation attempt on Section 17 has not been successful and the surface rock formations in the area are not responsible for the elevated radon levels in the area. Franke Declaration at 10-13; Abitz affidavit at 1-3.

The Staff's argument that one cannot distinguish background levels from radon emanating from other sources is also without merit, because as Mr. Franke and Dr. Abitz discuss, a regional radon study was performed after uranium mining commenced at Ambrosia Lake, and Mr. Franke has himself distinguished the various components of T in his response to question 2. Franke Declaration at 8-20; Abitz Affidavit at 2-3.

2. *Based on legal argument, empirical evidence and technical analysis, how should we calculate the annual TEDE to the individual member of the public likely to receive the highest dose from the HRI Churchrock operations? Include the TEDE from ISL processes. Also include the TEDE from source material and from byproduct material that is inside the geographic area that is part of the HRI Churchrock operations.*

As described in the legal analysis in the answer to question 1 above, and as discussed in Mr. Franke's Declaration at 2-3, the relevant components of man-made sources at Church Rock consist of the dose from HRI's proposed ISL operations (B), the dose from source and byproduct material on the HRI property, (C), the dose from source and byproduct material controlled by the NRC in active licenses (D), and from other sources and byproduct materials (E). Together these sources greatly exceed the regulatory limit of 100 mrem/yr in Part 20.

Mr. Franke details in his Declaration the calculation he made to derive the dose

from B, HRI's ISL operations. Id. at 8-12. *See also* Franke Report at 14-16 (January 5, 1999). He concludes "that there is a greater than 50% probability that the annual average Rn-222 concentration exceeds the limit of 10 CFR Part 20 for radon-222 in air of unrestricted areas (0.1 pCi/l with daughters present)." Franke Declaration at 14.

The existing source and byproduct material on the HRI site, C, is another man-made source that must be calculated as part of TEDE. Dr. Eggleston admits that the residue of the prior mining constitutes source and byproduct materials. Eggleston Affidavit at 2-3. HRI and the Staff have conflicting positions on the status of Section 17. The Staff admits that remediation is not complete and the area remains a potential source of radon emissions. McKenney Affidavit at Paragraph 6. HRI however, makes the general assertion that the impact of previous mining has been mostly removed. Eggleston Affidavit at 2-3. The Staff is correct that remediation is not complete and Section 17 likely still contains contaminated soils and pond embankments. Franke Declaration at 9-11; 16-17. More importantly, HRI has not presented any data confirming its claim that the site has been remediated to natural background. Id. at 9-11. Mr. Franke points out that it is extremely difficult to isolate the radon emissions from the HRI property, because of the close proximity of other sources. Id. at 16-17. To make a conclusive determination, it "would take at least one year to determine annual average radon levels in the area." Id. He finds that it is possible that ambient radon concentrations from these sources are greater than 0.2 pCi/l (100 mrem). Id. at 17. Based on the 1987 data, gamma

levels above background are contributing about 300-350 mrem/yr. Id. at 9.

The dose from other NRC licensed sources, D, is also part of TEDE. The UNC uranium mine and milling site, including a 400 acre tailing pile, is licensed under SUA-1475. Id. at 4; Abitz at 3. The Rio Puerco, which runs within a mile of the HRI site, contains contamination from nearly twenty years of discharges and the 1979 tailings spill. Franke Declaration at 19. This NRC licensed activity is within the scope of the Part 20 TEDE, as explained in detail in the answer to Question 1 above.

The dose from other prior mine and milling operations in Church Rock is part of the TEDE. There are ten abandoned mine sites, several of which are downwind, surrounding the HRI site. Abitz Affidavit at 2-3; Testimony of Dr. Christine Benally, Table 4, Exhibit P, in support of ENDAUM's and SRIC's environmental justice presentation (January 19, 1999). Like other NRC licensed sources, these unlicensed sources are man-made and are therefore included in the Part 20 standard. See answer to question 1 above. As Mr. Franke points out, "otherwise members of the general public would not be adequately protected against undue radiation exposures." Franke Declaration at 6-7. Unfortunately for HRI, Church Rock is the site of significant degradation from previous uranium mining operations that occurred within a well-populated area. The NRC cannot ignore the existing doses from these operations and simultaneously protect public health.

Mr. Franke has determined that combined together, all licensed and unlicensed

prior mining and milling operations (D and E) likely exceed the Part 20 limit of 0.2pCi/l (100 mrem). Id. at 19. ²

In summary, Mr. Franke finds that the TEDE for the HRI project, excluding natural background would be 1,250 mrem/yr. He concludes, "Such a high dose poses a significant health threat to the neighboring population." Id. at 20.

3. ***For the purpose of responding to Question [2], what is the appropriate location of the individual likely to receive the highest dose from the HRI Churchrock operations? Please supply additional estimates of annual radiation doses at locations specified by other parties.***

As LBP-99-15 recognizes, HRI has chosen to use the compliance standard in 10 C.F.R. § 20.1302(b)(1). LBP-99-15 at 10. That standard requires a licensee to comply with TEDE by "demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit."

The Staff asserts that 10 C.F.R. § 20.1302(b)(1) "allows a licensee to calculate (or measure) the dose to the real individual who is likely to receive the highest dose." Staff Response at 4. The Staff provides no authority for evaluating Part 20 compliance by reference to a "real" person. Where the Commission has proposed a standard for a "real person" it has done so explicitly. Proposed Rule for Yucca Mountain, 64 Fed. Reg. at 8652. Moreover, identifying a "real" person for Part 20 compliance does not make

² Though a cover was placed on the UNC tailing pile, radon readings remain high (1.03 pCi/l annual average ambient Rn-222). Id. at 20. These sources can increase ambient radon concentrations for more than a mile, and can cause an elevated background condition over an even larger area. Id. at 17-20.

practical sense. Regardless which "real person" is chosen today, another individual may later be located closer to the source. Because emissions from HRI's operations will fluctuate, rather than subject individuals to a continuous dose, the maximum dose could be received within a short period, such as a couple of hours. Therefore, an individual on the site boundary, such as a person herding livestock, or a road construction worker, is more likely to be hit with the highest dose than the nearest resident. Franke Declaration at 21. Accordingly, it is conservative to assume that the individual receiving the highest dose is the person at the site boundary. However, even assuming that the person likely to receive the highest dose is the nearest resident, Mr. Franke's analysis does not change, because the elevated levels of radon in the area are present over a large area. Id.

4. *Based on legal argument and technical analysis, how did you determine the geographic area that should be considered part of HRI operations in answer to Question [2]?*

10 C.F.R. § 20.1003 defines site boundary as "that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee." The entirety of Section 8, Section 17, as well as portions of Sections 16 and 12 at Church Rock are either owned, leased, or otherwise controlled by HRI. Id. at 22; COP Rev. 2.0 at 17, 25, 40, 42-43. These areas therefore comprise the site boundary. Even if the site were limited to Sections 8 and 17, or just Section 8, however, Mr. Franke's analysis would not change because of the high dose levels over a large area surrounding the site. Franke Declaration at 22.

Respectfully submitted,


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Before Administrative Judge Peter B. Bloch, Presiding Officer

In the Matter of)	
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HYDRO RESOURCES, INC.)	Docket No. 40-8968-ML
2929 Coors Road)	
Suite 101)	ASLBP No. 95-706-01-ML
Albuquerque, NM 87120)	
)	

CERTIFICATE OF SERVICE

I hereby certify that:

On April 7, 1999, I caused to be served copies of the following:

**EASTERN NAVAJO DINÉ AGAINST URANIUM MINING'S AND SOUTHWEST
RESEARCH AND INFORMATION CENTER'S RESPONSE TO LBP-99-15,
QUESTIONS CONCERNING RADIOACTIVE AIR EMISSIONS**

to the following parties marked by an asterisk via e-mail and express mail. Service was made upon the remaining persons by U.S. mail, first class, and in accordance with the requirements of 10 C.F.R. § 2.712. The envelopes were addressed as follows:

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Staff

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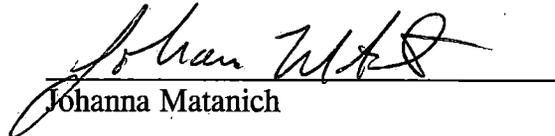
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Dated at Santa Fe, New Mexico,
April 7, 1999,


Johanna Matanich

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judge Peter B. Bloch

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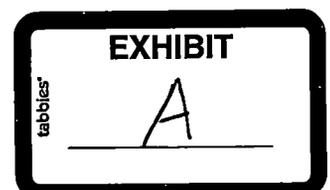
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DECLARATION OF BERND FRANKE

I, Bernd Franke, on behalf of Eastern Navajo Diné Against Uranium Mining ("ENDAUM") and Southwest Research and Information Center ("SRIC"), submit the following responses to the questions regarding radioactive air emissions issues, posed by the Presiding Officer in his Memorandum and Order of March 18, 1999. My qualifications were set forth in my previous testimony and in my Curriculum Vitae, submitted on behalf of ENDAUM's and SRIC's Brief Regarding Radioactive Air Emissions at the Crownpoint Project (January 11, 1999) Exhibits A, 1 ("Intervenors' Presentation").

In addition to the materials referenced in my previous testimony and report, I have reviewed the following materials:

- Hydro Resources Inc.'s Response Regarding Air Emissions, including the affidavit of Dr. Eggleston (February 11, 1999) ("HRI Response")
- NRC Staff's Response to Intervenors' Presentation on Air Emissions Issues, including the affidavit of Mr. McKenney (February 18, 1999) ("Staff Response").
- The Presiding Officer's Memorandum and Order (March 18, 1999).
- Testimony of Dr. Christine Benally in support of ENDAUM's and SRIC's presentation on environmental justice issues (February 19, 1999).
- Other documents as cited in this declaration.



I have prepared answers to the four technical questions posed in the court order as detailed below.

1. Based on empirical evidence and analysis, what portion of the total effective dose equivalent (TEDE) from the Churchrock site should not be considered to be background radiation because it is from source material or from byproduct material?

Based on the analysis that follows, I believe that at least half, and as much as 90 percent, of the observed ambient radon concentrations measured in and around the HRI Church Rock mining site since 1980 are from source, byproduct and technologically enhanced (i.e., anthropogenic) radioactive materials. The corollary of this finding is that natural *background radiation* accounts for a small portion of the total effective dose equivalent (TEDE) at the Church Rock site. All of these sources of radiation dose must be considered and accounted for in the TEDE calculation. I will review each of these components in the paragraphs that follow.

The total effective dose equivalent at the Church Rock site (*T*) can be expressed as

$$T = A + B + C + D + E$$

A = Dose from natural background

B = Dose from ISL operations

C = Dose from existing source and byproduct materials at the HRI property before startup of ISL operations

D = Dose from other source and byproduct materials which are not located on the HRI property but are regulated by the Commission by active licenses and affect the dose of member of the public in the vicinity of the Church Rock site

E = Dose from other source and byproduct materials affecting the area even though the materials may not be regulated by the Commission by active licenses but are a significant contributor to the dose of member of the public in the vicinity of the Church Rock site.

10 C.F.R. Part 20 restricts the exposure of the public by placing limits on the total effective dose equivalent (TEDE). The TEDE is the total dose equivalent minus natural background, or *T-A* and should not exceed 100 mrem in any given year¹. According to 10 C.F.R. Part 20, continuous exposure to 0.2 pCi/l of radon in air results in an annual dose of 100 mrem TEDE. It is certainly not easy to distinguish between the various components but it can be done, on the basis of existing data, and, as I pointed out in my January 5 report, has been done in the Ambrosia Lake uranium-mining district near Grants, N.M. Before I discuss, and in some cases quantify, the contribution of each of the five TEDE components in detail, I would like to explain why I believe they have to be included in the determination of compliance with 10 CFR Part 20.

A, the dose from natural background, which can be determined directly, either by field measurements or calculations, is a necessary component in the compliance assessment.

There is no question that the dose that results from emissions of radioactive materials from the licensed activity (**B**), in this case, the ISL operation, has to be included. This is the only dose that was quantified in the FEIS, although I take issue with the uncertainty of the results as expressed in chapter 4 of my January report.

The dose from existing source and byproduct materials on the HRI property before startup from ISL operations (**C**) is clearly not background since it fulfills two criteria

¹ The contribution of weapons test fallout and the Chernobyl accident to levels of external gamma radiation and radon in New Mexico is insignificant and is ignored in the further discussion.

defined in 10 CFR § 20.1003. It is source and byproduct material regulated by the Commission, and in addition, the material is clearly under the control of the licensee.²

What distinguishes **C** from **D**? The only difference is that the dose resulting from **D** is not on the property of the licensee while **C** is. **D** is the dose from other source and byproduct materials that are regulated by the Commission under active licenses. An example for **D** is the dose from radon that emanates from the uranium mill tailings of the United Nuclear Corporation (U.S.NRC license SUA-1475), north of the Church Rock site.

Now what about **E**, doses from other source and byproduct materials affecting the area even though the materials may not be regulated by the Commission through active licenses but are affecting the dose of members of the public in the vicinity of the Church Rock site?

In my opinion, **E** has to be accounted for in the compliance assessment as well. Examples for **E** are the releases of source and byproduct materials that resulted from prior uranium mining and milling activities in the area, which are currently not regulated by the Commission. My January 5 report contained a partial list in Table 2. Subsequent to filing my report, I was provided with a copy of Dr. Benally's testimony, which includes a much more comprehensive list (Exhibit 2-O) and a map (Exhibit 2-P) of uranium mining and milling operations in the Church Rock area. These radiation sources vary in importance and some are probably minor contributors to dose, especially if they are located at great distances from the Church Rock site. I will comment on how to calculate

² See letter from Mark Pelizza, HRI, to Holland Shepherd, State of New Mexico, Energy, Minerals and Natural Resources Department, page 2 (August 31, 1994), attached as Exhibit 1

the contributions from various sources in my response to the second question. The conservative estimate of the dose from these sources is in excess of 0.2 pCi/l.

If a license were sought for a new radiation source, as is the case with HRI, it would be inappropriate not to consider the dose resulting from regulated emissions from other nearby facilities simply because those emissions are not under direct control of the licensee. Why all sources of radiation releases should and must be included in the TEDE calculation is best explained with the following hypothetical example.

Suppose that the releases of a NRC licensed facility result in a TEDE of 75 mrem/yr and the operator, Company Z, wants to build an identical facility having identical releases next door. The impact area is identical because the emission sources are close to each other. The TEDE from the two facilities combined would bring the total TEDE to 150 mrem/yr. To receive a license, Company Z would have to reduce the releases from both facilities so that the dose from both sources combined does not exceed 100 mrem/yr.³

Now suppose that Company X intends to build the identical second facility, with the same releases, next to Company Z's plant. Under HRI's and NRC's interpretation of the 10 CFR Part 20 limits, Company X would be granted a license because its own releases are less than the 100 mrem/yr standard, even though those same releases, when combined with the releases from Company Z's plant, reach 150 mrem/yr, or 50 percent greater than the limit. Company X would simply assert that releases from Company Z's facility are not under its control and should therefore be counted as background.

Such a scenario is neither consistent with the dose standards nor NRC's ALARA policy, but it is precisely the outcome that HRI and NRC Staff are advocating. The definition of background radiation specifically excludes "radiation from source, byproduct, or special nuclear materials regulated by the Commission."

Material generated by another licensee is definitely not background, no matter who has control over it. A license must thus limit exposures from multiple sources. That is why I believe that doses from other source and byproduct materials not regulated by the Commission, but which are contributing to doses to members of the public (i.e., TEDE component *E*) must also be accounted for in the compliance assessment. Radiation releases from source and byproduct materials from prior uranium mining and milling activities in the Church Rock area are the principal contributors to this TEDE component.

As I will discuss in more detail in my answer to Judge Bloch's second question, three other pieces of evidence also support my view that radiation releases from other uranium mining and processing sites (Components *D* and *E*) are significant contributors to ambient radon levels in the area: Dr. Benally's list of previous uranium mining and milling operations; recent radon monitoring data for the UNC tailings site; and the conclusions of Dr. Richard Abitz in this supplementary testimony on air emissions that there are no uranium-mineralized formations in close proximity to the HRI Church Rock site that can explain the anomalously high natural radon levels measured there.

As set forth in 10 CFR § 20.1001 (b), the purpose of Part 20 is to regulate the use, transfer, and disposal of licensed material by any licensee "in such a manner that the

³ For the purposes of this discussion, I did not address ALARA requirement.

total dose to an individual (including exposures to **licensed and unlicensed** radioactive material **and** from radiation sources other than background radiation) does not exceed the standards" [emphasis added]. 10 CFR § 20.1301 further specifies that "[e]ach licensee shall conduct operations so that [t]he total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 millisievert) in a year, exclusive of the dose contributions from background radiation". When applied to the HRI case, the appropriate interpretation of these requirements seems clear: all licensed and unlicensed materials above background have to be accounted for. If, however, HRI's interpretation of the regulation were to prevail, cumulative exposures far above the limit of 100 mrem/yr TEDE would theoretically result. I cannot and do not believe that such an interpretation is consistent with the wording and intent of the regulation. If source and byproduct materials are affecting the area, it does not matter where they are located.

Can this lead to the predicament mentioned in paragraph 3 of Mr. McKenney's affidavit that "licensees could violate a license condition or the dose limit in part 20 without releasing anything?" Yes it can, for otherwise members of the general public would not be adequately protected against undue radiation exposures. This is part of the risk that a licensee faces if he chooses to do business in an area already affected by non-background radiation sources. In such a case, a licensee can still improve the situation by contributing to remedial efforts to bring the doses from non-background sources below the compliance limit.

2. Based on legal argument, empirical evidence and technical analysis, how should we calculate the annual TEDE to the individual member of the public likely to receive the highest dose from HRI Churchrock operations. Include the TEDE from ISL processes. Also include the TEDE from source material and from byproduct material that is inside the geographical area that is part of the HRI Churchrock operations.

My answer to this question addresses all 5 components of the equation $T = A + B + C + D + E$ explained above.

Calculation of natural background (A)

In situations where no activities involving the release of radioactive materials have been performed, the TEDE from natural background can be determined by appropriate measurements before startup of operations. Due to the variability of natural background activities (especially in the case of radon), such measurements need to be sufficiently representative and should cover a time period of at least one year, preferably several years.

In the case of the HRI license, such measurements do not exist⁴. We therefore have two options:

- (a) Infer natural background **A** by using appropriate surrogate data such as measurements at comparable locations.
- (b) Alternatively, we could rely on measurements of existing radiation exposures at the site before startup of ISL operations which can be expressed as $(T - B)$, positively identify and quantify all non-background contributions (**C**, **D** and **E**) and calculate because

$$A = T - (B + C + D + E)$$

In my January 5, 1999 report, I selected option (a) and inferred the natural background activity using appropriate surrogate data for the two relevant components of natural background in this case: external gamma radiation and radon.

Natural background of external gamma radiation

There is no available record of reliable gamma radiation readings before the startup of uranium mining and milling in the area of the proposed Church Rock ISL mine. I therefore based my determination of background on the isopleth map of gamma readings taken by HRI in 1987 and provided by HRI in its original (April 1988) and revised (March 1993) Church Rock Environmental Report (Figure 2.9-1). These readings show evidence of elevated dose rates due to prior mining activities at the site. I selected readings at the upwind monitoring sites of 10 to 15 $\mu\text{R/hr}$ as natural background even though the mining at the Church Rock site may have influenced these locations as well.⁵ In my January 5 report, I pointed out that the isopleth at the Route 566 intersection with the site is approaching 50 $\mu\text{R/hr}$, so that the non-background dose rate is about 35 to 40 $\mu\text{R/hr}$, which is equivalent to ~300 to 350 mrem/yr for that location.

HRI claims in its Response (at 8) that "gamma radiation is not transported through wind and therefore, Intervenors' speculative assertions are baseless." This statement is based on an improper reading of my report. While gamma radiation indeed is not transported by wind, radium-bearing tailings from mining operations are subject to being transported by prevailing winds. Since radium is a gamma emitter, tailings plume is expected to extend outward in the prevailing wind direction. This is exactly what one

⁴ HRI's 1987-88 radon measurements at Section 8 and UNC's 1980-81 radon measurements were taken long after mining and milling operations had commenced in the Church Rock area.

⁵⁵ Gamma radiation rates reported for nine monitoring stations used in the 1985 Buhl Study were within the range of rates at the Church Rock site: 11.1 $\mu\text{R/hr}$ to 15.4 $\mu\text{R/hr}$.

sees in Figure 2.9-1 of the HRI Environmental Report, which I reproduced as Figure 6 of my January 5 report.

Dr. Eggleston, in his February 10, 1999 affidavit, claims that the influences of previous mining and milling activities have been "largely removed since 1987 (removal of pond sediments, surface clean-up, sealing of old mine shafts and vents)." His assertion in this regard is baseless because he provides absolutely no confirmatory soil sampling or gamma-radiation field survey data to support it. Furthermore, the correspondence I have reviewed between HRI and staff of the New Mexico Mining and Minerals Division ("MMD") regarding prior reclamation of the HRI Section 17 site also is completely void of any actual radiological data. On the contrary, MMD documents indicate that MMD inspectors determined in 1995 that reclamation is incomplete for the concrete ore pad, pond embankments and site revegetation.⁶ Again, I did not find any measurements of radiation levels that can serve as a verification of the claim made by Dr. Eggleston that the site is no longer a source of anthropogenic radiation. Based on the information available to me, therefore, the most recent data for external gamma radiation at the site are from 1987, and the radiological condition today must be presumed to be what it was then — gamma levels ranging from 20 μ R/hr to 350 μ R/hr at the location where the main ore shaft and ore pad were located. Further testing would be necessary to establish whether, and to what extent, levels have decreased.

Moreover, NRC's own expert, Mr. McKenney, apparently agrees that HRI's Section 17 remains a source of radiation: "The underground mine site on the adjacent Section 16

[sic] (see FEIS, at 3-20) has never been completely remediated, and remains a potential source of technologically enhanced background radon emissions". (McKenney Affidavit at paragraph 6, and see FEIS at 3-55).

Natural background of radon

As in the case of external gamma radiation, there are, to my knowledge, no measurements of radon before uranium mining began in the Church Rock area in the 1960s. Based on my professional experience, I determined that there are three possible surrogates for natural radon background at the Church Rock site:

- Measurements at other areas in close proximity where no mining has taken place (high specificity);
- Measurements at other mining sites in New Mexico (medium specificity); and
- Measurements at other areas in the US (low specificity).

The use of each of the three surrogates is associated with its own strengths and weaknesses. I selected the measurements at Crownpoint of 0.2 pCi/l as a proxy for the unknown background at Church Rock. This selection is justified because it is based on nearly three dozen annual average measurements taken over a four-year period in the closest comparable area where no conventional uranium mining and milling had ever occurred.⁷ The total observed average radon concentration at Church Rock in 1987-88

⁶ New Mexico, Energy, Minerals and Natural Resources Department, Prior Reclamation Inspection Report and Recommendation for Release or Permit Requirement, September 18, 1995.

⁷ See data are summarized in Table 1 and Exhibits A, B and C of my January report.

was 2 pCi/l⁸; if we assume that natural background (A) is 0.2 pCi/l, then $(C+D+E) - (A) = 2.0 - 0.2 \text{ pCi/l} = 1.8 \text{ pCi/l}$, which is the concentration of non-natural background radon attributable to technologically enhanced sources of radiation in the Church Rock area.

Alternatively, one may select other data such as Mr. McKenney did who quoted "a range of estimated annual average radon concentrations, from 0.016 pCi/L for Kodiak, Alaska, to 0.75 pCi/l for Grand Junction, Colorado". Despite being of low specificity, even if one were to select the upper limit of the two values to represent natural background, then $(C+D+E) - (A) = 2.0 - 0.75 \text{ pCi/l} = 1.25 \text{ pCi/l}$ of non-natural background radon.

In my January report, I cited the 1985 study by Buhl et al. (New Mexico Health and Environmental Department) (hereinafter, "Buhl Study"), which contained results of two long-term measurements of radon background for the Ambrosia Lake, N.M., mining district. The average "selected" background values ranged from 0.42 pCi/l (04/78 to 02/79) to 0.53 pCi/l (04/79 to 03/80). (See, Table 1 at 13 and Exhibit C of my January report.) If the higher of the two values is selected for natural background, then $(C+D+E) - (A) = 2.0 - 0.53 \text{ pCi/l} = 1.47 \text{ pCi/l}$ of non-natural background radon.

Dr. Eggleston claims in paragraph 4 of his affidavit that "[t]he geology is highly variable in terms of surficial mineralization and ambient radon-222 can be expected to range widely throughout the area naturally. Elevated radon-222 is not conclusive evidence for anthropogenic activity associated with uranium mining." As Dr. Abitz, who is a geologist by education and training (Dr. Eggleston is not), confirms, the rock formations that exist

⁸ The actual average of the three monitoring stations at Section 8 in 1987-88 was 2.2 pCi/l. See my page 11 and Exhibit D of my January report for details.

at the land surface at Church Rock are not likely to emit radon-222 at any level approaching 2 pCi/l because they do not contain uranium mineralization. Dr. Abitz estimates, again based on the same surrogate average radon concentrations that I am citing here, that radon from these formations can account for only 10 percent to 25 percent (i.e., 0.2 to 0.6 pCi/l) of the elevated ambient radon-222 levels in the area.

In support for his theory, Dr. Eggleston also quotes the ranges of radon measurements at sites in Texas. For instance, he reports that the upper limit of concentrations measured at Kingsville Dome in the period 7/83 to 5/84 was 2.2 pCi/l with a range of 0.12 pCi/l to 2.2 pCi/l. He does not indicate what the annual averages were for these data. The annual average is a more meaningful figure than either end of the range. The range of individual radon measurements can be quite large, as indicated by the range of radon values reported for Church Rock of 0.10 pCi/l to 13.4 pCi/l (see DEIS at 3-19). That is a much larger range than the range reported for Kingsville Dome.

In view of the range of measurements cited by Dr. Eggleston, it does not appear to be likely that the annual average at Kingsville Dome is more than ~1 pCi/l. If, for the sake of argument, we would assume that the natural background concentration at Church Rock is 1 pCi/l (as opposed to data from locations in New Mexico that suggest much lower background levels), the $(C+D+E) - (A) = 2 \text{ pCi/l} - 1 \text{ pCi/l} = 1.0 \text{ pCi/l}$ of non-natural background radon.

Regardless of which value for natural background is chosen, the concentrations measured at Church Rock above background are at least around 1 pCi/l, and more likely to be much higher. In my review of the literature, I could not find any report of annual

average concentrations of natural radon background in ambient air of the Western part of the United States which are as high as the levels reported for Church Rock.

Dose from ISL operations (B)

I provided a detailed account of how to address this matter in my report. In summary, I concluded that for the upper case scenario, there is a greater than 50-percent probability that the annual average Rn-222 concentration exceeds the limit of 10 CFR Part 20 for radon-222 in air of unrestricted areas (0.1 pCi/l with daughters present).

Here, I would like to address the criticism expressed by Mr. McKenney in his affidavit. In paragraph 9 he claims that I used an incorrect conversion factor to calculate TEDE resulting from a given radon level in air. He claims that exposure to 2,880 pCi/l over one hour results in a radiation exposure of 25 mrem. However, his calculation is not in agreement with 10 CFR Part 20. According to Appendix B, Table 2, an annual average air concentration of 0.1 pCi/l would produce a total effective dose equivalent (TEDE) of 50 mrem. The exposure to an air concentration of 0.1 pCi/l over a single hour is:

$$50 \text{ mrem yr}^{-1} / 8760 \text{ hrs yr}^{-1} = 0.0057 \text{ mrem}$$

In order to receive a dose of 25 mrem from an exposure over one hour, the air concentration during that hour must be $25/0.0057 = 4386$ times larger than 0.1 pCi/l. Hence, the radon concentration that results in a 25-mrem TEDE is 439 pCi/l, a factor of 6.6 smaller than the one claimed by Mr. McKenney.

Second, Mr. McKenney takes issue with the "worst case scenario" as he puts it. He selected the lowest dispersion coefficient from my Figure 8 ($8.0 \times 10^{-6} \text{ s/m}^3$) to calculate

the required radon source term that would result in an air concentration of 2,880 pCi/l, averaged over one hour. The equation is simply:

$$\text{air concentration [pCi m}^{-3}\text{]} = \text{source term [pCi s}^{-1}\text{]} * \text{dispersion coefficient [8.0x10}^{-6}\text{ s m}^{-3}\text{]}$$

If the one does not know the source term, the equation is:

$$\text{source term [pCi s}^{-1}\text{]} = \text{air concentration [pCi m}^{-3}\text{]} / \text{dispersion coefficient [8.0x10}^{-6}\text{ s m}^{-3}\text{]}$$

In order to result in an air concentration of 2,880 pCi l⁻¹ (= 2.88x10⁶ pCi m⁻³), a source term of 3.6 x 10¹¹ pCi s⁻¹ would be required if the dispersion coefficient is assumed to be 8.0x10⁻⁶ s m⁻³. The source term translates into an average radon concentration in the groundwater of 1.6x10⁹ pCi l⁻¹. This concentration is indeed 1000 times larger than the maximum observed concentration and very unlikely to occur. However, Mr. McKenney is mistaken in his assumption that this is the way I performed the uncertainty analysis. His mistake in the above calculation simply is that he divided the air concentration by the **lowest** dispersion coefficient (i.e. the **maximum dilution**) in my Figure 8. This of course maximizes the source term. The correct way would be to use the **highest** dispersion coefficient (i.e. the **minimum dilution**) for the calculation, which is 2.0x10⁻³ s/m³, a factor of 250 larger than the value used by Mr. McKenney.

I corrected the two errors in Mr. McKenney's calculation and determined that, using the appropriate factors, a 25 mrem dose during from one hour of exposure is caused when the source term is 2.2x10⁸ pCi s⁻¹. The source term translates into a groundwater concentration of 980,000 pCi l⁻¹, a value which is well within the observed range.

Dr. Eggleston asserts that "the question of uncertainty should be minimal" regarding the radon exposures from the proposed project. His assertion is unfounded because:

- (a) The radon source term is based on few measurements; the uncertainty of the limited database cannot be accurately quantified.
- (b) Dr. Eggleston does not provide proof for the assertion that the water is commingled and that the source term is continuous; nor has HRI provided such proof. The source term does not become continuous because of a repeated claim that is continuous. In fact what little evidence exists indicates that it is **not** continuous.⁹

I therefore confirm that my calculations were not based on absurdly large concentrations of radon in the groundwater.

Dose from source and byproduct material on the HRI property (C)

Mr. McKenney states that "the underground mine site on the adjacent Section 16 [sic, Section 17] (see FEIS at 3-20) has never been completely remediated, and remains a potential source of technologically enhanced background radon emissions." In contrast, Dr. Eggleston states that "[t]he influences of previous mining and milling activities have been largely removed since 1987 (removal of pond sediments, surface clean-up, sealing of old mine shafts and vents)." I have not found any measurements of levels of radiation exposures that can serve as a verification of the claim made by Dr. Eggleston (see response to question 1). The most recent data of external gamma radiation and radon in ambient air is from 1987.

How much radon is being emitted from the HRI property? Because there are so many sources of emissions close to the HRI site, this question is impossible to answer without a thorough investigation of the site that would take at least one year to determine annual

⁹(See, e.g., FEIS at 4-74, which states that pressure values on wellfield trunk lines discharge for 2 seconds every 5 minutes.)

average radon levels in the area. However, based on the available information, it appears that the contribution from the HRI site is significant. Significant levels of gamma radiation at least 23 times background were measured at the Church Rock site in 1987. These levels are a clear indicator of the presence of radium-226 in soils and wastes at the site. Since Ra-222 is the progeny of Ra-226, it is quite likely that the residual radioactive materials at the site are causing ambient radon concentrations greater than 0.2 pCi/l at the site boundary.

Dose from source and byproduct material controlled by the NRC in active licenses and from unlicensed operations (D and E)

Dr. Eggleston asserts that radon from mine vents, tailings, and other mine related surface sources would not influence ambient radon beyond 800 m (2600 ft). This assertion is not correct. While air concentrations from a point source will decrease with distance and at some point indeed become indistinguishable from natural background, there is no magical distance at which radon disappears. For example, Buhl et al. (at 15 and 27-28) reported that some Ambrosia Lake monitoring sites located greater than 1.5 miles from mills and mines had elevated radon levels because they were located in the local air "drainage pattern" that channeled radon from its sources over large distances.

Reported values for the decrease in concentrations with distance are a function of the type of the source, the definition of "background", atmospheric conditions and other factors. A study by the National Research Council, for example, suggests that "for most inactive tailings piles, background levels of radon are reached in about 0.3 to 5 km"¹⁰. This is shown in Figure 1, taken from page 53 of the same report. One should, however,

be careful in correctly interpreting Figure 1 by understanding that levels described as "background" should more properly be described as "elevated background" because of the overlapping impact of many local sources. Similar effects are observed with conventional pollutants such as NO_x in metropolitan areas where the contribution of many large and small sources, such as power plants and cars, cause levels far above the natural NO_x background. The impact of a large source, say a coal power plant, can become indistinguishable from the ambient levels that are nevertheless elevated above the natural background due to the impact of many sources nearby and far away. In this case, as in the case of large radon sources, it would be wrong to assert that "natural background" is the level at which the impact of the large source is no longer measurable. Only a careful analysis of the local sources and the atmospheric dispersion conditions can determine the correct answer.

¹⁰ National Research Council. Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings. Washington DC: National Academy Press. 1986, p. 49

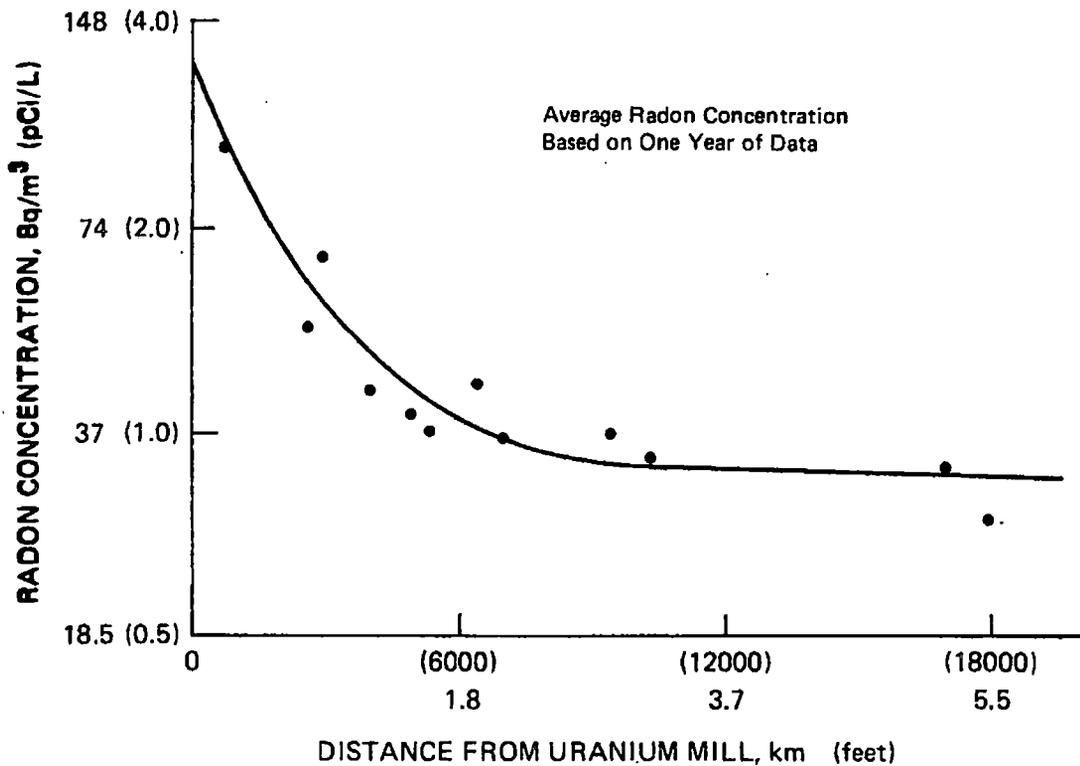


Figure 1. Variation of atmosphere radon concentration with distance, Shirley Basin/Mill Complex. (Source: National Research Council, 1986)

Two sources of radon in close proximity to the Church Rock site are the Puerco River and the United Nuclear Corporation uranium tailings facility. The Puerco received radionuclide-laden mine-water discharges from 1969 to 1986 and uranium mill process liquids in the 1979 tailings spill. Radon precursors from these byproduct materials accumulated in the now-dry riverbed, which at its closest point is less than one mile from the HRI site. Radon exhalation from these materials is quite possibly contributing to local radon levels of 0.2 pCi/l or greater.

Similarly, the UNC tailings site remains a source of elevated radon, as evidenced by results of recent radon monitoring there conducted by UNC and reported to the NRC.¹¹ According to these data, average radon flux from the tailings in 1998 was 5.71 pCi/m²/s; this value follows installation of a radon-attenuation cap in 1995. Annual average ambient Rn-222 "at the site with the highest result" was 1.03 pCi/l. These levels are far above those expected from natural background¹² and are similar to those reported near mill tailing sites. Based on these data and my experience with atmospheric dispersion, it is likely that the contribution of the Church Rock tailings site to radon levels at HRI's Church Rock ISL site exceed the compliance criterion of 0.2 pCi/l.

Total Dose to the Public

In summary, I reaffirm the conclusion of my January report that the dose from source and byproduct materials above natural background at the Church Rock site exceeds the 10 C.F.R. Part 20 compliance limit of 100 mrem/yr by a large margin. Assuming that 0.2 pCi/l is the expected contribution from natural background, then the non-background activity at the Church Rock site is 2.0 pCi/l minus 0.2 pCi/l, which equals 1.8 pCi/l and is equivalent to 900 mrem TEDE per year. Adding the above-background external gamma dose of ~300 mrem/yr, the total dose *above background* (i.e., **C + D + E**) would be 1,200 mrem TEDE per year. Including the median dose (50% probability) from the proposed ISL operations, or 0.1 pCi/l (50 mrem TEDE) for the upper case scenario, then the TEDE for the project, excluding natural background, would be 1,250 mrem. Such a high dose poses a significant health threat to the neighboring population, which, as shown by Dr. Benally, numbers at least 850 people.

¹¹ United Nuclear Corporation (UNC). Letter by Edward M. Morales to Ross Scarano, U.S. NRC Region IV, December 10, 1998, attached as Exhibit 2.

3. For the purpose of responding to Question 3¹³, what is the appropriate location of the individual likely to receive the highest dose from the HRI Churchrock operations? Please supply additional estimates of annual radiation doses at locations specified by other parties.

A person at the plant boundary is the individual likely to receive the highest dose. As explained in my report in greater detail, it would be inappropriate to ignore the discontinuous nature of radon releases from the ISL operations, which results in the fact that the total annual dose to the individual likely to receive the highest dose may be delivered over a few hours. A more transient individual, rather than the nearest resident, is therefore the individual likely to receive the highest dose. It is entirely possible that an individual, such as a local resident herding livestock or a road construction worker, may be at the plant boundary on State Route 566, which runs through Section 17. It would therefore be a mistake to use the location of the nearest residence as the compliance "point." For that reason, I selected the plant boundary as the relevant receptor area. For purposes of compliance with 10 CFR 20, it is also the edge of the "unrestricted area."

Even if one were to ignore these considerations, it appears that the existing levels of radon at the closest residence already exceed the compliance limit of 0.2 pCi/l (= 100 mrem/yr TEDE). The elevated levels of radon appear to be present in a rather large area because all three locations monitored at the Church Rock site in 1987-88 (8R1, 8R2 and 8R3) had radon levels far above natural background.

¹² Buhl et al. (at 40) reported that "normal soil radon emanation values for New Mexico" range from 0.5 to 2.0 pCi/m²-s.

¹³ Since I use a different numbering scheme, this refers to question 2 in this response.

4. Based on legal argument and technical analysis, how did you determine the geographic area that should be considered part of HRI's operations in answer to Question [2]?

HRI's license generally authorizes ISL mining at the "Church Rock site". License Conditions 9.1 (authorized place of use "includes the Crownpoint, Unit 1, and Church Rock uranium recovery and processing facilities") and 10.28 (requirement of restoration demonstration "at the Church Rock site"). HRI's Church Rock site includes Sections 8 and 17. Consolidated Operations Plan 2.0 (August 15, 1997) at 17, 25, 40 ("The Churchrock satellite will consist of one mine unit, which will be developed in two phases: the Section 8 phase, and the Section 17 phase. The mine area (the area completely contained within the monitor well ring) will consist of approximately 200 acres."). I have considered Sections 8 and 17 to be part of HRI's operations in my answer to Question 2.

In addition, HRI has identified Section 16 as its preferred land application site for waste water from the Church Rock operation. COP 2.0 at pages 42-43. Other possible sites include a portion of Section 17 and flat mesa land on portions of Section 8 and Section 12 (T16N, R17W). COP 2.0 at pages 42-43. I have also considered these sites to be part of HRI's operations in my answer to Question 2.

Again, even if the scope of operations were restricted to Section 8 or Section 17, the analysis in my answer to Question 2 would not change. The elevated levels of radon appear to be present in a rather large area because all three locations monitored at the Church Rock site in 1987-88 (8R1, 8R2 and 8R3) indicate radon levels far above natural background.

AFFIRMATION

I declare on this 6th day of April, 1999, at North Potomac, Maryland, under penalty of perjury that the foregoing is true and correct to the best of my knowledge, and the opinions expressed herein are based on my best professional judgment.

A handwritten signature in cursive script, reading "Bernd Franke", written in black ink. The signature is positioned above a horizontal line.

Bernd Franke

HRI, INC.

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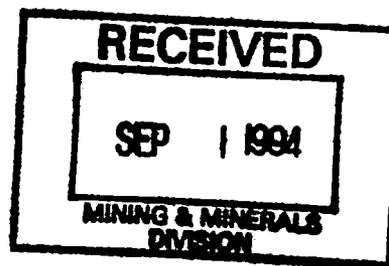
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VIA FEDERAL EXPRESS

August 31, 1994

Mr. Holland Shepherd, Chief
Mining Act Reclamation Bureau
STATE OF NEW MEXICO
Energy, Minerals and Natural Resources Department
2040 Pacheco Street
Santa Fe, New Mexico 87505



Dear Mr. Shepherd:

The following letter will be HRI, Inc.'s response to your letter dated July 28, 1994, where you asked for additional information regarding the prior reclamation status at the Churchrock mine. Additionally, a check covering the \$250.00 inspection fee is attached. I have formatted this response by first restating your question and then responding appropriately.

1. A map of 1:24000 or larger scale (1:12000) showing the limits of the reclaimed area and the location, and a description, of any waste units, impoundments, stockpiles, leach piles, open pits or adits that are within this area;

Response:

A copy of the U.S.G.S. Churchrock Quadrangle map is within Attachment A with HRI's Churchrock Mine Site (Lease) outlined.

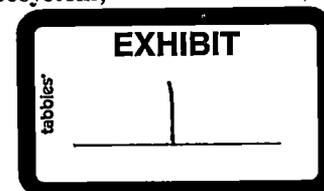
2. A discussion of post-mining land use, for the site reclaimed;

Response:

Attachment B contains a Proposed Wellfield Site Layout which has been developed pursuant to the licensing activities with the U.S. Nuclear Regulatory Commission (NRC). The land area which was affected by previous conventional mining activity is delineated within the pink-shaded area and the location of future in-situ wellfields which will be regulated by NRC is illustrated.

As can be seen, with the exception of the location of ponds 1-5, the area that had previously been affected by conventional mining fall within in-situ wellfields. The pond embankments are being left in place in the event HRI needs to utilize them during in-situ mining. All sludge has been removed from these ponds. All these activities will be regulated by the NRC in the near future..

3. A detailed description of the reclamation work performed, including types of reclamation conducted, amount of acres revegetated, the seed mix used, the current condition of the revegetation, etc., and how the reclamation project has been designed to achieve a self-sustaining ecosystem;



Response:

Reclamation has been performed by the previous operator, United Nuclear Corp. (UNC). UNC removed all remaining ore material, over-burdened stockpiles, buildings and other facilities from the site. As a result, the entire site is graded to approximately the original topographic grade.

UNC, with HRI as Contractor, removed all of the contaminated material from the five ponds which were used by UNC to treat mine water for Radium 226 removal by barium chloride treatment, prior to surface discharge. All of the contaminated material was disposal of offsite.

All that remains at this time is the old mine headframe, the ion exchange plant and the pond embankments. The headframe belongs to UNC and will remain in place indefinitely until removed by UNC. The ion exchange plant will be used during in-situ mining. The ponds will be left in place in the event they are used for in-situ mining.

The area affected by previous mining has not been reseeded. However, over time, a vegetation cover has re-established itself through wind-blown seed, and other natural processes. We feel that the vegetation cover is self-sustaining.

4. **If part of the reclamation, a discussion of how the current reclamation of waste units, impoundments, stockpiles, tailings piles open pits or adits, have been designed to ensure compliance with all applicable federal and state standards for air, surface and ground water protection, and to eliminate any future hazards to health and public safety.**

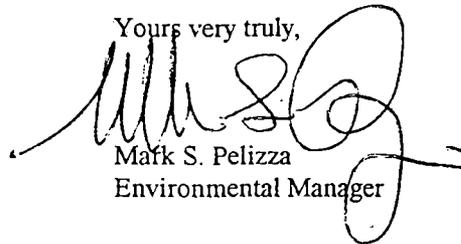
Response:

As has been mentioned previously, the Section 17 location is currently being licensed for in-situ mining by the NRC. A Federal Environmental Impact Statement is being prepared. As a NRC licensed area, HRI will be required to comply with all the regulation of the NRC and the Atomic Energy Act (AEA). Additionally, in-situ mining requires permits from the New Mexico Environment Department (NMED) and the Environmental Protection Agency (EPA). Therefore, environmental matters pertaining to air, surface or ground water will be thoroughly regulated during in-situ mining activities.

At this time, however, we seek prior reclamation status with EMNRD as required by the New Mexico Mining Act. Regardless of future environmental controls that will be implemented by other state and federal regulatory agencies, we feel that the Churchrock property now is in a state that one would consider a self-sustaining ecosystem. In fact, we hope the purpose of the inspection will be to determine and advise HRI if that status has been achieved.

I look forward to meeting your inspector in the field. Please contact me with questions pertaining to this matter.

Yours very truly,



Mark S. Pelizza
Environmental Manager

MSP/dlg
Encl. (Check)

cc: Bill McKnight, Jr./URI, Inc./Corpus Christi, TX 78411

UNITED NUCLEAR CORPORATION



P.O. Box 3077
Gallup, New Mexico 87305-3077

Telephone: (505) 722-6651
Fax: (505) 722-6654

December 10, 1998

'99 JAN 20 09:12

U.S. Nuclear Regulatory Commission
Region IV
Attn: Ross Scarano, Director
Division of Radiation Safety and Safeguards
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-4351

40-8907

Gentlemen:

Pursuant to License Condition 28A of our License SUA-1475, submitted herewith are the results of our ALARA Audit conducted on December 10, 1998

If you have any questions, please advise.

Sincerely yours,

Edward M. Morales
General Manager and
Radiation Safety Officer

EMM:r

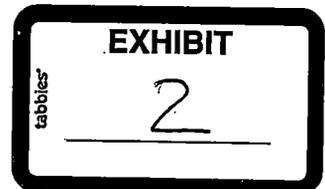
Enclosure

cc: J. Velasquez, UNC
USNRC, Div. of Waste Management

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ENVIRONMENTAL MONITORING SUMMARY DATA

For 4th-Q 1997 to 3rd-Q 1998

<u>Environmental Monitoring</u>	<u>Required Analysis</u>	<u>Highest Result Obtained</u>	<u>Allowable</u>
◦ Qtly Air Sample Composite:	U-Nat. ($\frac{\mu\text{Ci}}{\text{ml}}$)	2.82E^{-16}	9.00E^{-14} (Effluent)
(Also note: Alara Goal is 10-20% or less of effluent limit depending on circumstances)	Th-230 ($\frac{\mu\text{Ci}}{\text{ml}}$)	2.99E^{-16}	3.00E^{-14} (Effluent)
	RA-226 ($\frac{\mu\text{Ci}}{\text{ml}}$)	3.94E^{-16}	9.00E^{-13} (Effluent)
	PB-210 ($\frac{\mu\text{Ci}}{\text{ml}}$)	1.55E^{-14}	6.00E^{-13} (Effluent)
◦ Qtly Ambient Radon:	RN-222 ($\frac{\mu\text{Ci}}{\text{ml}}$)	1.50E^{-9}	1.00E^{-8} (Effluent)
(Also note: Annual Average = 1.03E^{-9} $\mu\text{Ci}/\text{ml}$ at the site with the high result)	(-Daughter)		
◦ Semi-Annual Area TLD:	Gamma ($\frac{\text{mrem}}{\text{yr}}$)	*14.9	25 (Clean-up Std.) 100 (TEDE Annual Limit)
◦ Qtly Ground Water GW-Wells:	U-Nat ($\frac{\text{mg}}{\text{l}}$)	0.073 (dissolved)	0.30 (NRC) 5.0 (ARAR)
(Also Note: 2 of 4 qtly. dissolved analysis = <1.0 pci/l and the LLD = 1.0 pci/l for Po-210 analysis. Annual average = <3.7 pci/l).	Th-230 ($\frac{\text{pci}}{\text{l}}$)	<0.20 (dissolved)	5.0 (NRC) 15.0 (ARAR)
	RA-226 ($\frac{\text{pci}}{\text{l}}$)	1.30 (dissolved)	5.0 (NRC) 5.0 (ARAR)
	PB-210 ($\frac{\text{pci}}{\text{l}}$)	<1.0 (dissolved)	1.0 (NRC)
	PO-210 ($\frac{\text{pci}}{\text{l}}$)	9.60 (dissolved)	1.0 (NRC)
	PH (units)	7.20	6-9 (NMED)

* Based on the combined summation of high results (i.e. at Site F 2nd Half of 97 = 12.0 mrem and at Site F 1st half of 98 = 6.0 mrem) above Site D's background results.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judge Peter B. Bloch

_____)	
In the Matter of)	
HYDRO RESOURCES, INC.)	Docket No. 40-8968-ML
2929 Coors Road Suite 101)	
Albuquerque, NM 87120)	ASLBP No. 95-706-01-ML
_____)	

AFFIDAVIT OF RICHARD J. ABITZ

1. I, Richard J. Abitz, on behalf of Eastern Navajo Diné Against Uranium Mining ("ENDAUM") and Southwest Research and Information Center ("SRIC"), submit the following information to supplement the response of Mr. Bernd Franke to the questions regarding radioactive air emissions issues, posed in LBP-99-15. My qualifications as a professional geologist and geochemist are set forth in my previous testimony and in my resume, submitted in support of ENDAUM's and SRIC's Presentation on Groundwater Protection (January 11, 1999), Exhibits 1 and A, respectively. As shown in my resume, I have worked on geologic and geochemical issues at the UNC Church Rock uranium mill site and spent hundreds of hours assessing the groundwater quality data for the Crownpoint Uranium Project as a consultant to ENDAUM and SRIC.

2. The purpose of my testimony today is to address Questions 2 and 3 of LBP-99-15 concerning the contribution of uraniferous rock formations to natural background radiation. It is my opinion, as a professional geologist, that no geologic formations containing mineable concentrations of uranium exist at the surface of the site of HRI's proposed Church Rock ISL mine, and therefore, that all or a substantial portion of the

tabbles
EXHIBIT
B

elevated radon levels measured there in 1987-88 cannot possibly be coming from the local surficial rock formations via natural radon emanation. Dr. Alan Eggleston, who evinces no direct experience or educational qualifications to render an opinion on the geology of the Church Rock site, states without hesitation in his February 10 affidavit:

Elevated radon-222 levels have been associated with naturally occurring radiation in all portions of the world where radioactive minerals containing the uranium series are a component of the near surface geology (Table 1). The area of New Mexico including the Church Rock and Crownpoint sites has such geology.

Eggleston Affidavit at 3. Dr. Eggleston cites not a single Church Rock-area formation, by age or name, or a single relevant geologic reference, to substantiate his claim that the Church Rock site "has such geology." The principal uranium-bearing formations at the site are the Dakota Sandstone, which begins about 550 feet below land surface, and the Westwater Canyon Member, which begins about 700 feet below land surface. (See, FEIS at 3-8 to 3-12.) These "uraniferous" formations do not outcrop until more than four miles south of the site. None of the sedimentary rocks at the surface, the Mancos Shale, the Gallup Sandstone and the Crevasse Canyon Formation, have ever been mined for uranium, and none of these is known to contain uranium deposits.¹

3. The immediate area around the Church Rock site is not comprised of uranium-bearing formations, as is much of Ambrosia Lake. Yet there, the average annual levels of background radon, as reported in the Buhl Study (1985),² were at least 4 times less than those measured by HRI at the Church Rock site 11 to 12 years ago.³ The Church Rock

¹ See, L.S. Hilpert at 43-46, cited in Franke Report at 14.

² See, Exhibit C of Bernd Franke's January 5, 1999, report, attached at Exhibit 2 to ENDAUM's and SRIC's Presentation on Radioactive Air Emissions (January 11, 1999).

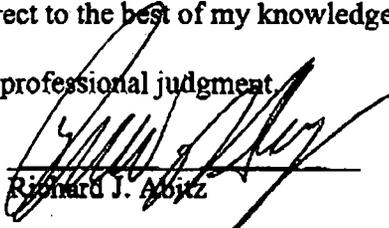
³ As discussed in Mr. Franke's January report and in his April 6, 1999, affidavit addressing the questions in LBP-99-15, the Buhl Study determined average annual radon and radon progeny concentrations in the Ambrosia Lake uranium mining district in 1978-1980. Three active uranium mills, four tailings piles, and 20 underground uranium mines were operating in the district at the time of the study. Average radon

site, on the other hand, is ringed by several sources of anthropogenic radon: 10 abandoned uranium mine sites, a 400-plus-acre uranium tailings pile, and contaminated sediments in the Puerco River.⁴ And the site itself remains a source of radon from radioactive materials left there by the previous mining operation.

4. Based on the evidence discussed here and by other experts in this case, I conclude that local rocks account for very little (from 10 percent to 25 percent) of the high levels of radon measured at the HRI Church Rock site.

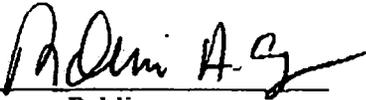
AFFIRMATION

I declare on this 7 day of April, 1999, at Ross, Ohio, under penalty of perjury that the foregoing is true and correct to the best of my knowledge, and the opinions expressed herein are based on my best professional judgment.


Richard J. Abitz

Sworn and subscribed before me, the undersigned, a Notary Public in and for the State of Ohio on this 7 day of April, 1999, at Hamilton, Ohio.

My Commission expires on August 30, 1999


Notary Public



ROBINA CARY
NOTARY PUBLIC
STATE OF OHIO
MY COMMISSION
EXPIRES AUGUST 30, 1999

concentrations in air were measured at 33 locations, including seven background sites in the Ambrosia Lake-Grants area and two background sites in Crownpoint. The study (at 28) noted that there "is some evidence that background could be lower than used here," because at least one station may have been affected by radon releases from a mill located more than 1.5 miles away. Additionally, the study reported that the average radon concentration from air sampling conducted in six different "undisturbed areas" in the Grants Mineral Belt in the late 1970s was 0.19 ± 0.02 pCi/l, or 10 times less than the Church Rock average.⁴ See, Table 4 and Exhibit P of testimony of Dr. Christine J. Benally, attached as Exhibit 2 to ENDAUM's and SRIC's Presentation on Environmental Justice Issues (February 19, 1999).