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NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

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Washington, D. C. 20555

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Thomas D. Murphy  
Special Assistant  
Atomic Safety and Licensing Board  
Mail Stop T-3 F23  
U.S. Nuclear Regulatory Commission  
Washington, D. C. 20555

In the Matter of  
HYDRO RESOURCES, INC.  
Docket No. 40-8968-ML

Dear Judges Bloch and Murphy:

Pursuant to Judge Bloch's March 18, 1999 order (LBP-99-15, "Questions Concerning Radioactive Air Emissions") (March 18 Order), and 10 C.F.R. § 2.1233, the staff is required to answer under oath or affirmation five questions concerning radioactive air emissions in the area of Hydro Resources, Inc.'s (HRI's) Church Rock site. See March 18 Order, at 10, ¶¶ 2-6. Accordingly, the Staff's answers are in affidavit form. See the enclosed affidavit of Christopher McKenney (McKenney's April Affidavit). The remainder of this letter responds to the March 18 Order's request for legal argument.

Mr. McKenney's earlier affidavit, dated February 18, 1999 (McKenney's February 18 Affidavit), explained the significance of the underground mine site on Section 16 as being "a potential source of technologically enhanced radon emissions" since it had never been completely remediated.<sup>1</sup> The presence of this mine, in addition to the other old mines on HRI's section 17 site, explains why background levels found at HRI's Church Rock site are higher than those found at Crownpoint. See McKenney's February 18 Affidavit, at ¶ 6; and McKenney's April Affidavit, at ¶ 3.

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<sup>1</sup> McKenney's February 18 Affidavit, at ¶ 6. The March 18 Order missed this reference in mistakenly citing ¶ 5 of McKenney's February 18 Affidavit. See March 18 Order, at 5 and n.3.

However, contrary to the Presiding Officer's supposition,<sup>2</sup> there are no tailings in the Section 17 mines contributing to the background radiation level. All tailings from United Nuclear Corporation's (UNC's) Church Rock mining operation are located at the UNC mill site, which HRI does not own and has no control over.<sup>3</sup> The Church Rock area over which HRI does have some control is depicted in the FEIS Figures 2.8 and 2.10, showing the lease boundaries on Sections 8 and 17. Within this area, ISL well fields would be placed during HRI's Church Rock operations.

This area forms the logical as well as legal boundary to use when calculating the annual total effective dose equivalent (TEDE) amount attributable to HRI's ISL mining. Any underground ore outside the lease boundary would not be subject to ISL mining under HRI's NRC license.<sup>4</sup> Moreover, underground ore which is not being mined is not material regulated by the Commission,<sup>5</sup> regardless of whether such ore would qualify as source material. Radiation from such underground ore is thus considered to be part of "background radiation." *See* 10 C.F.R. § 20.1003 definition (last sentence). For the same reasons, any radon releases from the UNC mine shafts at Church Rock are part of background radiation, since the underground ore producing such radiation (even if it exceeds the 0.05 weight percent definition of source material) is not being mined.

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<sup>2</sup> *See* March 18 Order, at 8. The Presiding Officer may have been misled by the February 19, 1999, presentation on cumulative impact issues, at 26, which the Staff noted failed to make clear that United Nuclear Corporation's (UNC's) Church Rock mine and the UNC Church Rock mill are on different sites two miles apart. *See* "NRC Staff's Response To Intervenor's Presentation On cumulative Impact and Segmentation Issues, dated April 1, 1999, at 4 and n.8. *See also* Figure B3-8, submitted as part of "Exhibit E to Franke Report," more clearly depicting the UNC mill's location on section 2.

<sup>3</sup> A further inaccuracy in the Presiding Officer's analysis is the implication from the chain of title discussion that HRI owns the section 17 land. *See* March 18 Order, at 8. On the contrary, HRI only has lease interests in that land. *See* FEIS Figures 2.8 and 2.10.

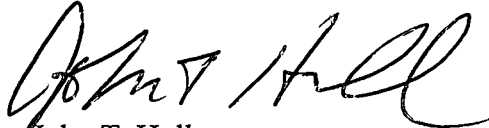
<sup>4</sup> Even assuming that a well field is placed at the edge of HRI's lease boundary, and that uranium-laden lixiviant is thereby drawn in part from an underground ore body extending past the surface lease boundary, none of the thus depleted underground ore body (neither the part inside nor outside the lease area) would be considered "byproduct material." *See* 10 C.F.R. § 20.1003 definition (last sentence).

<sup>5</sup> Uranium ore only becomes material for which an NRC license is required "after removal from its place of deposit in nature." Atomic Energy Act, Section 62, 42 U.S.C. § 2092. *See also* April 28, 1980, NRC legal opinion, Attachment A, at 3-4 and n.6, attached as HRI Exhibit G to its February 11, 1999, presentation on financial qualification issues.

Accordingly, ore not being mined, and ore outside HRI's lease boundary, are sources of background radiation which should not be counted as part of the annual TEDE amount attributable to HRI's ISL mining.

The FEIS discussion of combined radiation impacts, and the failure to include data from the draft environmental impact statement, are addressed in McKenney's April Affidavit (attached).

Sincerely,



John T. Hull  
Counsel for NRC Staff

Enclosure: As stated

cc w/enclosure:

Diane Curran, Esq.  
Jep Hill, Esq.  
Richard Clement, Jr.  
Mitchell Capitan

Douglas Meiklejohn, Esq.  
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Anthony J. Thompson, Esq.  
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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE PRESIDING OFFICER

In the Matter of )  
 )  
HYDRO RESOURCES, INC. ) Docket No. 40-8968-ML  
2929 Coors Road, Suite 101 )  
Albuquerque, New Mexico 87120 )

AFFIDAVIT OF CHRISTEPHER A. MCKENNEY

I, Christopher A. McKenney, being duly sworn, declare as follows:

1. I am competent to make this affidavit, and the opinions expressed herein are based on my best professional judgment. I am employed by the U.S. Nuclear Regulatory Commission in the Office of Nuclear Material Safety and Safeguards. As part of my duties since 1995, I have worked on the Hydro Resources, Inc. (HRI) license application to conduct *in situ* leach (ISL) mining. I have reviewed HRI submittals in the areas of health physics, operations, and radiological impacts from potential land application. My resume has previously been filed in this proceeding, and describes my general background, training, and other qualifications to express the opinions stated herein. Additionally, I was the principal author of the FEIS sections at issue here.

2. In this declaration I will answer the questions propounded by the Presiding Officer in LBP-99-15 (hereafter referred to as the March 18 Order).

3. The first question asks what portion of the total effective dose equivalent (TEDE) from the Church Rock site<sup>1</sup> should not be considered part of background radiation, either because it is from "source material" or from "byproduct material."

In this answer I will estimate the fraction of radon produced by the presence of either source material, or byproduct material, that may be considered to be under the control of HRI (*i.e.*, such material which lies on lands under its control for mining purposes).<sup>2</sup> As noted in the March 18 Order, radiation produced by source material, or byproduct material, is excluded from the definition of background radiation.

HRI's Church Rock site is the former location of a non-ISL uranium mining operation. However, no milling of the mined uranium took place at this site, meaning that no uranium ore was processed there. Accordingly, remnants of any uranium/thorium ore, or overburden material, left behind at the site are not "byproduct material" under the definition of this term in 10 C.F.R. § 20.1003.

Under the definition of the term "source material" in 10 C.F.R. § 20.1003, a material qualifies as such if it is ore which contains, by weight, 0.05 percent, or more, of uranium/thorium. There is no such material present on the ground surface of Section 17, where the old underground mine site and ore pad were located. While the soil concentrations right around this mine site are elevated over soil concentrations found elsewhere on Section

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<sup>1</sup> For purposes of answering this question, I am ignoring the legal bifurcation of the proceeding, and treat Sections 8 and 17 as one site.

<sup>2</sup> HRI's applicable area of control is assumed to be the Church Rock lease areas on Sections 8 and 17, as depicted in FEIS Figure 2.8, on page 2-25.

17 (*see* DEIS page 3-20, and HRI's Table 2.9-1 from its March 1993 environmental report)<sup>3</sup>, none of the concentrations exceed the 0.05%, by weight (alternately, 500 parts per million), definition of source material.

Only one soil sample in Section 8 exceeded the 0.05%, by weight, definition of source material. This sample is discussed at page 155 of HRI's 1993 report, and is designated as Soil Sample 8S-16 in HRI Table 2.9-1. This sample was found to have a 650 parts per million concentration of uranium (0.065 wt%), and is thus considered to be source material. This sample also had a radium (the parent of radon) concentration of 49 pCi/g. Because the HRI sample data does not provide a detailed description of the sample's horizontal extent (from the data the vertical extent appears to be less than 0.3 meters (1 foot)), assumptions need to be made on the total amount of residual activity produced by this sample, in order to calculate what portion of the HRI Church Rock site's radon measurements may be due to this source. If I conservatively assume that this sample is representative for an area of 10 square meters at a depth of 0.3 meters (1 foot), the total radon production of this volume over one year would be 0.2 Ci. If I further assume that all of the radon escapes from this ground area into the atmosphere, the resulting annual TEDE exposure to the nearest resident would be a small fraction of one millirem.

As a comparison, the FEIS modeled two assumed source terms present during ISL mining at HRI's Church Rock site - the well fields (2.96 Ci radon released per year) and the satellite facility (1.78 Ci released per year). *See* FEIS, at pages 4-82 to 4-83. The modeling

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<sup>3</sup> This HRI report was part of its license application, and its HRI Hearing File number is 9304130415. In addition to Table 2.9-1, relevant information appears at page 155 of the report, and in Figure 2.9-2 therein.

of these two source terms resulted in an annual dose of 0.25 millirem TEDE to the nearest resident. As stated in the FEIS, this TEDE is "a small fraction of the regulatory limits" [of .1 rem, as stated in 10 C.F.R. § 20.1301(a)(1)].<sup>4</sup> FEIS, page 4-83. Moreover, the location of soil sample 8S-16 (*see* HRI Figure 2.9-2 in its 1993 environmental report) is further away from the nearest resident than the release points of the two sources modeled in the FEIS. Therefore, because the source terms modeled (1) had approximately 2 orders of magnitude greater releases than the releases from the area around soil sample 8S-16, but still only resulted in an annual dose of one-quarter (0.25) of one millirem; and (2) were closer to the nearest resident than is the area around soil sample 8S-16, the FEIS correctly evaluated a conservative, bounding condition. In other words, the FEIS modeled condition results in a higher annual TEDE to the nearest resident than that produced by soil sample 8S-16, but one which is still a fraction of the 10 C.F.R. § 20.1301(a)(1) allowable limit of 100 millirems.

I add here the important point that pursuant to 10 C.F.R. § 20.1301, the background level of radiation that may exist at a site does not act as a bar to licensed activities at the site. The key factor is whether the licensed activity itself will meet the 100 millirem requirement. As stated in the FEIS, at pages 4-83 and 4-124, HRI's proposed ISL mining easily meets this requirement.

I also take this opportunity to comment further on the opinions of Mr. Bernd Franke, as I believe the March 18 Order gives undue weight to those opinions. A non-ISL underground uranium mine can increase radon release into the environment by providing

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<sup>4</sup> For ease of reference, and for comparison purposes, I hereafter convert the .1 rem limit to its equivalent of 100 millirems.



preferential 'fast' pathways for radon gas to reach the atmosphere through the mine's various shafts and conduits. The underground shafts remove a great deal of the intervening rock, which usually limits the release of radon from deep deposits of ore to the atmosphere. As a result, the radon can escape up the air-filled shafts before its short half-life (3.8 days) causes it to decay from a highly mobile, non-reactive noble gas, to elements that are reactive. Reactive elements move very slowly, if at all, through the original rock matrix. These enhanced radon releases from non-ISL underground uranium mines thus come from a technologically enhanced, naturally occurring radioactive material,<sup>5</sup> rather than from material regulated by the Commission. While underground uranium ore present in abandoned mines may be greater than the 0.05%, by weight, definition of source material, the Commission does not regulate such ore. Abandoned or not fully remediated mines (i.e., those mines with shafts and vents not closed off) can remain a long-term source of technologically enhanced radon releases to the local environment. With the relatively high concentration of old uranium mines in the Church Rock chapter area (*see* Exhibit O attached to the testimony of Dr. Christine Benally),<sup>6</sup> the technologically enhanced emissions from these sites could potentially be a substantial source for the difference in the measured

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<sup>5</sup> As defined by the National Academy of Sciences, in its 1999 "Evaluation for Guidelines for Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials," technologically enhanced natural occurring radioactive materials are any naturally occurring radioactive materials not subject to regulation under the Atomic Energy Act, whose radio nuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities. I believe such materials in the Church Rock area produce what Mr. Franke refers to as non-background radiation.

<sup>6</sup> The Staff does not waive its objection to accepting Dr. Benally's testimony.

background radon concentrations between HRI's Church Rock site and the town of Crownpoint.

To summarize my answer to the first question, I believe only a very small portion (a fraction of one millirem) of the annual TEDE from HRI's Church Rock site should not be considered to constitute background radiation.

4. The second question asks what is the proper method to calculate the annual TEDE to the individual member of the public likely to receive the highest dose from HRI's Church Rock operations.

The dose assessment should use an applicable air transport code, such as MILDOS-AREA, to estimate doses to the nearest resident - who should be the highest exposed individual if you assume a long occupancy time at that location. Since releases from ISL operations are fairly continuous over the length of a year, and the compliance demonstration is to the individual likely to receive the highest dose, the analysis should be calculated based on the annual average values of the site's meteorological conditions, rather than assuming worst-case meteorological conditions existing for an entire year. The average wind conditions account for both favorable dispersion situations, which tend to occur during the late morning to early evening, and calm or low wind speed periods that would reduce dispersion, which tend to occur at night or early morning. Therefore, the average wind conditions are a reasonable data set because the calm periods have reduced the "average" dispersion, even though most releases from HRI's satellite facility at the Church Rock site would occur during the day. I therefore disagree with Mr. Franke's statement that "50% of the annual average exposure can occur in a single hour." Franke Report, at 11. Estimations

of the source term releases should be conservative but reasonable. In the FEIS, we made very conservative estimations of source term released, as discussed in FEIS Section 4.6.1.2, at pages 4-82 to 4-83.

5. The third question asks for the appropriate location of the individual likely to receive the highest dose from HRI's Church Rock operations, and for annual dose estimates at locations specified by other parties.

The FEIS estimated annual TEDE doses to various off-site receptor locations near HRI's Church Rock site. *See* Table 4.18, at page 4-78. The person most likely to be the highest exposed individual is one of the individuals residing at the home that is directly downwind from HRI's Church Rock site. The location of this residence is depicted as CRR4, in FEIS Figure 4.5, on page 4-84. Individuals residing at this location are likely to be present for longer periods of time and, therefore, would face greater exposures from ISL radon effluents than would individuals who are there only for short periods of time. An individual at CRR 4 has an estimated annual exposure of one-quarter of one millirem TEDE from HRI's ISL operations. *See* Table 4.18, at page 4-78. As noted above in my answer to the first question, the single additional soil sample qualifying as source material on Section 8 would not influence this result.

Mr. Franke's Report describes a general location of an individual at the closest Church Rock fence line to the source. For Mr. Franke's fence line receptor, I used the data in FEIS Table 4.24, at page 4-85, to estimate the annual TEDE from HRI's satellite ISL facility. As can be seen in FEIS Figure 4.5, on page 4-84, the closest fence line receptor locations calculated were for B2, B3, and B4. I used the data with the radon capture system

working as proposed by HRI (listed as the pressurized system in FEIS Table 4.24). Looking at the working level estimates for the radon at the three locations, I decided to use an estimated working level concentration of  $1 \times 10^{-5}$  as a conservative estimate. Noted at the bottom of the table are the respective average annual effluent concentration numbers from Appendix B of 10 C.F.R. Part 20. Using the effluent concentration of  $1.1 \times 10^{-3}$  (0.0011) WL as equivalent to 50 millirem annual TEDE, Mr. Franke's fence line receptor would receive an estimated annual exposure of one-half of one millirem TEDE from HRI's ISL operations. I note that it is not necessary to calculate the dose contribution of the later decay products from the radon daughters (i.e., lead-210, bismuth-210 and polonium-210) because of their very low concentration (seven or more orders of magnitude below their respective effluent concentration numbers in Appendix B of 10 C.F.R. Part 20).

6. The fourth question asks how the determination was made regarding the geographic area that should be considered part of HRI operations in answering the second question.

The applicable area would be HRI's Church Rock site on its leased portions of Sections 8 and 17, as depicted in FEIS Figure 2.8, on page 2-25. From a technical standpoint, this area encompasses the ground on which ISL well fields could be placed during HRI's Church Rock ISL operations, and is where the satellite facility would be located.

7. The fifth question asks whether the FEIS adequately addressed the combined impacts of radiation expected to be produced by ISL operations, and from the elevated background levels of radiation in the Church Rock area.

Yes, it did. I first emphasize that the FEIS was not prepared in order to evaluate impacts of prior uranium mining. The object of the FEIS was to evaluate the impacts of the ISL mining as proposed by HRI. The FEIS adequately addressed the impacts from releases of radiation from HRI's proposed operations, which as discussed above are quite small.

Much has been made of the fact that the FEIS did not include Section 3.7 of the DEIS. This information regarded levels of background radiation at the Church Rock site, as reported by HRI during 1988 to 1993. The omission of Section 3.7 from the FEIS was inadvertent. Many sections of the FEIS refer to the elevated concentrations present in the Church Rock area. *See* FEIS Sections 4.6.2.1, 4.6.4, 4.12.4, 4.13.2, and 4.13.6. These sections were written with the assumption that the DEIS Section 3.7 information would be included in the FEIS. The FEIS findings and conclusions would not change based on inclusion of the Section 3.7 data. The Staff recognized that the site's background radiological data were dated, and the Staff accordingly specified license conditions that will require that HRI perform environmental monitoring prior to operations at a site, to clearly establish the environmental conditions existing before operations commence. *See* HRI License Conditions 10.30 and 9.8. Additionally, as noted in HRI's presentation dated February 11, 1999, regarding air emissions issues, HRI has performed site clean-up activities, centered around the old ore pads and mine shaft of the underground Church Rock mine, which had the most extensive elevated soil concentrations and gamma radiation dose rates.

In the ENDAUM and SRIC presentation on environmental justice issues, the FEIS analysis of the population dose estimates from natural background was questioned. Specifically, the breadth of the area was described as too large. I have reevaluated the population dose for the Church Rock area using the information supplied in Exhibit L of Dr. Bullard's testimony,<sup>7</sup> regarding the number of local residences (173), and used the five persons-per-residence average from his testimony (at page 20 thereof) to arrive at a total local population surrounding HRI's Church Rock site of 865. To add further conservatism, and to allow for possible under-reporting in the survey, I rounded the local population figure up to 1000. I used the national average dose to an individual from background radiation (*i.e.*, cosmic radiation, cosmogenic radio nuclides (*e.g.*, carbon-14, iodine-129), and primordial radio nuclides (*e.g.*, exposures from uranium and thorium other than indoor radon, potassium-40)), and medical sources of 225 millirem TEDE per year (*see* FEIS, page 4-72), to calculate a base population collective dose of 225 person-rem.

In addition to this national average base population exposure, one must account for the elevated background levels of radon in the area from the old uranium mines. The EPA's estimate of 180 millirem annual dose from indoor radon is based on the assumption that an individual spends 75% of his/her time indoors with a radon concentration of 1.2 pCi/l, and 25% of the time outdoors with 0.3 pCi/l<sup>8</sup>. Based on the 2.2 pCi/l outdoor average measured around HRI's Church Rock site (*see* DEIS, page 3-19), I used indoor concentrations of 4

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<sup>7</sup> The Staff does not waive its objection to accepting Dr. Bullard's testimony.

<sup>8</sup>Radon: Prevalance, Measurements, Health Risks and Control. ASTM Manual MNL 15. Niren L. Nagda, pg. 16.

pCi/l and 2.2 pCi/l, respectively, to calculate an annual local exposure (per individual) of 650 millirem from radon-222. The collective dose due to radon would then be 650 person-rem, resulting in a total collective population dose (adding the local 650 person-rem dose to the national average base population collective dose of 225 person-rem) of approximately 875 person-rem.

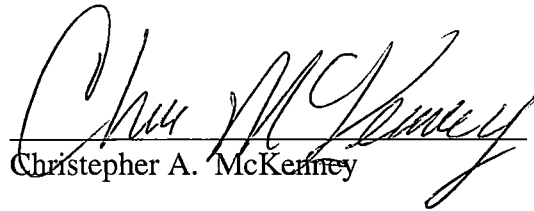
As a comparison, the estimated total population dose from all three of HRI's proposed ISL facilities (at Church Rock, Unit 1, and Crownpoint) to the population within 50 miles of the sites (a total of 76,500 people) was less than 1 person-rem. *See* FEIS, at page 4-124. Therefore, even if we assume that all of the collective dose from all three ISL facilities, operating at full capacity, was received by the local population (as estimated by Dr. Bullard) around HRI's Church Rock site, the cumulative impact to that population would be to raise the collective dose by less than 0.5%.<sup>9</sup>

I am aware of no studies showing that such a small increment to collective dose has any adverse public health consequences.

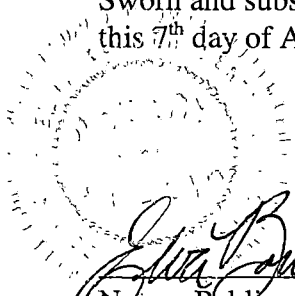
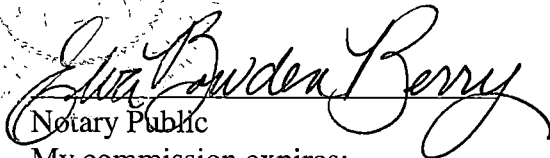
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<sup>9</sup> It must be noted that the collective dose used in the FEIS for the natural background (17,000 person-rem) did not include the exposure to indoor air, in order to maximize the relative impact of the ISL facilities.

8. The foregoing is true and correct to the best of my knowledge, information and belief.

  
Christopher A. McKenney

Sworn and subscribed to before me  
this 7<sup>th</sup> day of April, 1999

  
  
Notary Public

My commission expires:  
ELVA BOWDEN BERRY  
NOTARY PUBLIC STATE OF MARYLAND  
My Commission Expires December 1, 1999