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RELATED CORRESPONDENCE

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NUCLEAR REGULATORY COMMISSION

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OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

Louisiana Energy Services, L.P.
National Enrichment Facility

Docket No. 70-3103

ASLBP No. 04-826-01-ML

REBUTTAL TESTIMONY OF GEORGE RICE ON BEHALF OF NUCLEAR INFORMATION AND RESOURCE SERVICE AND PUBLIC CITIZEN NIRS/PC CONTENTION EC-1

Q1: Please state your name and address.

A1. George Rice; 414 East French, San Antonio, Texas

Q2: What is your profession and educational background?

A2. I am a groundwater hydrologist; I have an MS from the University of Arizona. My resume has been filed in this case as an attachment to the Petition filed on April 6, 2004.

Q3. Have you reviewed LES's testimony regarding EC-1?

A3. Yes.

Q4. Do you have a general opinion of the testimony?

A4. Yes. LES presents a series of assertions without the necessary analyses or site-specific data necessary to support them. I will address these assertions and, in some cases, make

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recommendations for confirming or refuting them. I will also address other issues regarding LES's testimony.

Much of the information that rebuts LES's testimony is contained in my prefiled testimony. In the interest of brevity I will reference most of this testimony rather than repeating it here.

Q5. On page 10 of its testimony, LES states that data obtained from the WCS site is applicable to the NEF site. Do you agree?

A5. I agree in part. For example, I would expect the lithology of the Chinle Formation to be similar at both sites. There are, however, significant differences with respect to the hydrology. At WCS, groundwater is present in the 230-foot Chinle zone across the entire portion of the site that has been investigated (NIRS/PC Exhibit 4, page 3, and NIRS/PC Exhibit 17, pages 72 – 73). In contrast, at the NEF site groundwater was found in only one of three wells completed in this zone (NIRS/PC Exhibit 4, table 2 and figure 5, and NIRS/PC Exhibit 17, page 54).

At WCS, the 230-foot zone in the Chinle is the uppermost water-bearing zone that extends across the entire site (NIRS/PC Exhibit , page 6-2). This is not true at the NEF site. Except for the northwestern portion of the site, LES has not identified the uppermost water-bearing zone (NIRS/PC Exhibit 4, table 2 and figure 5).

Q6. On page 51 of its testimony, LES claims that studies performed at the NEF and WCS do

not " ... *indicate that fractures and fast flow paths exist under the National Enrichment Facility site.*" Do you agree?

A6. No. Cores examined by Holt show that fractures in the Chinle are common at the WCS site. Fractures were encountered at various depths. Some were 'healed', while others showed signs that they had acted as groundwater flow paths, although the time the flow occurred is not known (NIRS/PC testimony, page 9).

LES does not appear to have thoroughly investigated the question of fractures at the proposed site (see NIRS/PC testimony, pages 8 and 9).

This question could be resolved by carefully collecting and examining cores from the proposed site, as Holt did at the WCS site. If no fractures capable of acting as preferred flow paths are found, then the question would be settled. However, if such fractures are found, then LES should be required to estimate the rate at which the fractures would transmit leakage from the NEF to underlying groundwater systems.

Q7. On pages 24, 26, 27, and 42 of its testimony, LES claims that water that leaks from the stormwater detention basin, and water that is discharged from the septic system, probably would not form perched bodies of water at the alluvial/Chinle because most of it would be returned to the atmosphere by evapotranspiration (ET). On page 26, LES states that a water balance supports this conclusion. Do you agree?

A7. No. First, it must be noted that LES has not performed an analysis of the amount of water that would leak from the stormwater detention basin. The water balance that LES

mentions in its testimony is not a serious attempt to estimate leakage rates (see NIRS/PC testimony, page 14).

Second, LES has not performed an analysis of the amount of leakage that would be returned to the atmosphere by evapotranspiration. Instead, LES cites the high evaporation rates in the area and refers to a paper by Walvoord et al. (NIRS/PC Exhibit 48) (LES testimony, pages 15 and 42). The paper concludes that no recharge occurs in thick desert vadose zones (LES testimony, page 15). This is no substitute for a site-specific analysis (see discussion below).

Third, LES's assertion is inconsistent with the existence of perched bodies of water below playas (buffalo wallows) at the WCS site (LES testimony, page 33). The stormwater basin would function like a playa. It would fill with rainfall or snowmelt, and water would leak into the subsurface. Perched bodies of water are likely to form beneath the stormwater basin, just as they form beneath the playas. In fact, LES states: "*Excavations into, and naturally occurring surface depressions ("buffalo wallows") in, the alluvium can act as "bowls" where water can more readily accumulate on top of the red-beds, which may allow localized perched zones to develop.*" (LES testimony, page 33). The stormwater basin would be an unlined excavation into the alluvium.

Finally, the septic systems would discharge wastes below the ground surface. To some extent, these discharges would be shielded from evaporation.

It should be noted that NRC has stated that perched bodies of water could be expected to form at the alluvial/Chinle contact as a result of leakage from the stormwater detention basin and discharges from the septic systems (NRC Exhibit 1, DEIS, pages 4-13 and 4-14) (NIRS/PC Exhibit 41).

If LES wants to credibly argue that perched bodies would not form, it should perform an analysis to estimate the amount of water that would leak from the stormwater basin. It should also perform analyses to estimate the amounts of leakage and septic discharge that would reach the alluvial/Chinle contact. Finally, it should perform analyses to estimate the amount of storm water leakage and septic discharge that would be returned to the atmosphere by evapotranspiration. If sound analyses show that perched bodies would not form, this question would be settled. However, if this is not the case, LES should be required to determine the fate of the perched bodies of water.

Q8. On page 27 of its testimony, LES states: *"Moreover, NIRS/PC appear to assume that the contact between the alluvium and Chinle red beds beneath the site is uniform with respect to depth below ground surface."* Did you make such an assumption?

A8. No.

Q9. On pages 24 and 25 of its testimony, LES claims that if any leakage did pond on the alluvial/Chinle contact, downgradient transport would be limited due to evapotranspiration and the storage capacity of the soils. Do you agree?

A9. No. Regarding evapotranspiration, LES has not performed any analyses that quantify the effects of evapotranspiration on water that may pond on the alluvial/Chinle contact.

Regarding soil storage capacity, LES has not performed any analyses that quantify the effects of soil storage capacity on the movement of perched water.

Indeed, LES has not performed any analyses that address the fate of perched water.

In order to demonstrate how far perched water would travel, LES should be required to 1) perform an analysis to estimate the amount of water that would perch on the alluvial/Chinle contact, and 2) perform an analysis to determine the fate of any perched water (i.e., flow direction, flow rate, distance traveled before dissipating due to evapotranspiration other factors), and 3) identify potential discharge areas in the flow path of the perched water.

Q10. On page 27 of its testimony, LES states that it is " ... *not aware of any points in the site vicinity at which water purportedly flowing along the "alluvial/Chinle contact" is discharged.*" Is this correct?

A10. No. LES is aware of at least one point where water flowing along the alluvial/Chinle contact is discharged. This is the Wallach quarry, where water seeps from " ... *the base of the sand and gravel unit at the top of the Chinle clay. ... This shallow perched zone is not likely to be pervasive ...* " (LES Exhibit 1, page 3.4-2).

There is no indication that LES has made a systematic effort to identify any areas where water flowing along the alluvial/Chinle contact is discharged.

Q11. On page 31 of its testimony, LES offers the following explanation for the moisture found in boring B-9: "*This moisture is likely infiltrated precipitation that had yet to evapotranspire (since CJI locates drilling locations in low spots rather than high spots, i.e., rainfall may preferentially collect and infiltrate into the ground and then become available for evapotranspiration).*" Do you agree that this moisture is 'likely infiltrated precipitation'?

A11. Yes. This differs from LES's previous explanation and is consistent with the explanation presented in my testimony (NIRS/PC testimony, pages 6 and 7).

I also agree that infiltration may be preferentially concentrated in areas such as low spots. This would result in the formation of preferential flow paths (NIRS/PC testimony, page 7).

However, I disagree with LES on the fate of the infiltrated precipitation. LES believes the infiltrated precipitation will be removed by evapotranspiration (LES testimony, page 31). I believe that a portion of the infiltrated precipitation probably makes its way to the alluvial/Chinle contact and flows along the contact. That is, the moisture found in boreholes at the NEF site, and at the WCS site, are indications of episodic recharge (NIRS/PC testimony, pages 6 and 7).

LES still has not offered a clear explanation of the source of the moisture found at the base of boring B-2 (alluvial/Chinle contact). LES should state whether it believes the source of the moisture in B-2 is the same as the moisture in B-9 (i.e., infiltrated precipitation), or whether the moisture originates from another source[1]. Finally, it should be noted that LES's hydrologist was not present when these borings were drilled (NIRS/PC Exhibit 17, pages 16 – 18).

Q12. On page 15 of its testimony, LES invokes a paper by Walvoord et al. (LES exhibit 5) (NIRS/PC Exhibit 48) to support its claim that infiltrating precipitation would be removed by evapotranspiration. Have you reviewed this paper?

A12. Yes, and I don't believe it can be used to show that all precipitation infiltrating at the NEF site would be removed by evapotranspiration.

First, the paper presents a new conceptual model of flow in desert vadose zones that differs from previous models (LES exhibit 5, pages 44-2 and 44-4) (NIRS/PC Exhibit 48). This is not to say that the conceptual model developed in this paper is incorrect. However, it is new, and subsequent research may cause it to be modified.

Second, the model assumes there are no preferential flow paths (LES Exhibit 5, page 44-5) (NIRS/PC Exhibit 48). Preferential flow paths currently form at the site when

[1] Note: contrary to LES's implication (LES testimony, page 50), I have not claimed that the moisture found in these boreholes reflected saturated conditions. I have asked LES to explain the origin of this moisture.

precipitation is concentrated in depressions or beneath sand dunes (LES testimony, page 31, and NIRS/PC testimony, page 7).

Finally, although Walvoord's paper may cast light on the movement of water through desert vadose zones, it is not a substitute for site-specific analyses.

Q13. On page 23 of its testimony, LES states that contaminant concentrations in water leaking from the stormwater basin will not exceed regulatory limits. On page 24, LES states that this will be confirmed by samples collected from the basin. Do you agree?

A13. No. One of the purposes of collecting samples is to determine whether discharges comply with regulatory standards. LES will not know whether water in the basin meets regulatory standards until samples are collected and analyzed.

In support of its contention, LES cites statements in Barrett, et al. (1995, NIRS/PC Exhibit 2) regarding the potential for contaminants in highway runoff to affect groundwater (LES testimony, page 53). It is true that soils can reduce the concentrations of contaminants in runoff, and that thicker soils and sediments generally result in greater reductions.

However, this does not mean that contaminants in the stormwater runoff from the NEF (generated in part from parking lots and roads) would not contaminate leakage that perched on the alluvial/Chinle contact. Barrett et al. describe cases where contaminants associated with highway runoff have affected the underlying groundwater (NIRS/PC

Exhibit 2, page 44). In addition, the contaminant removal capacity of the alluvial materials underlying the proposed site is unknown. The alluvium would remove some contaminants, but there is no reason to believe it would remove all contaminants.

LES should be required to analyze stormwater for the contaminants that it would reasonably be expected to contain (NIRS/PC testimony, page 21). Because the stormwater basin would leak, groundwater samples should be analyzed for contaminants detected in the basin. This should include samples from wells designed to intercept any leakage that perches on the alluvial/Chinle contact.

Q14. Has LES changed its position regarding the potential for leakage from the lined basins?

A14. Yes. LES had claimed that the lined basins would not leak (NIRS/PC exhibit 24, pages 5 and 6). However, in its testimony LES states: " *The liners ... will greatly minimize, if not entirely preclude, the potential for subsurface infiltration of water collected in these basins.* " (LES testimony, page 26). And " ... *catastrophic failure is not considered a credible event* ... "(LES testimony, page 46)[2]. In his deposition, Mr. Harper stated that he had heard of cases where liners have leaked (NIRS/PC Exhibit 17, pages 117 and 118).

Although LES now concedes that leakage may occur, they claim that an analysis of the leakage is unnecessary because 1) the lined basins will only contain low concentrations of contaminants, 2), any leakage is not likely to migrate, and 3) " ... *LES will implement*

[2] It should be noted that I have never claimed that catastrophic failure would occur. I have stated that lined basins often leak, and that LES should estimate the amount of leakage that may occur. NRC has also stated there is a possibility that the basins will leak (NRC testimony concerning EC-1, page 15).

a monitoring program designed to detect any postulated releases to the environment."
(LES testimony, pages 46 and 47).

Taking these arguments in order:

1) Although LES hopes that contaminant concentrations will always be below regulatory limits, there is no guarantee that this will be the case. As stated above, one of the purposes of collecting samples is to determine whether discharges to basins comply with standards.

2) Migration of leakage along the alluvial/Chinle contact is addressed above. In the absence of leakage rate estimates, it is not possible to determine the extent of migration.

3) LES plans to install five monitor wells. However, only one of them will be capable of detecting leakage migrating along the alluvial/Chinle contact. The planned position of this well makes it unlikely that it would intercept leakage from any of the basins (LES testimony, pages 37 and 38, NRC Exhibit 1, figure 6-2, and NIRS/PC Exhibit 4, figure 4).

LES should be required to estimate leakage rates from the lined basins, and determine the fate of any leakage that would pond on the alluvial/Chinle contact.

Q15. On page 49 of its testimony, LES claims that the geomembrane leakage data in Laine and Miklas are not germane to NEF. Do you agree?

A15. No. The data in Laine and Miklas come from a variety of geomembrane-lined sites including tanks, ponds, and landfills (NIRS/PC Exhibit 22, page 36). The primary factors that cause geomembranes to leak are common to all lined facilities. These are: 1) manufacturing defects, 2) installation defects, and 3) deterioration after installation (NIRS/PC testimony, pages 17 and 18). The lined basins at NEF would be also subject to these factors. Therefore, the data are germane to the NEF.

Q16. On page 45 of its testimony, LES states that the TEEB liner will stay within the manufacturer's specifications. Will the manufacturer guarantee the liner's integrity?

A16. LES is not aware of any warranties offered by geomembrane manufacturers (NIRS/PC Exhibit 17, page 48).

Q17. On page 46 of its testimony, LES discusses a hypothetical uranium infiltration depth. Has LES performed any analyses to estimate the depth to which uranium may infiltrate?

A17. Not as of September 2004 (NIRS/PC Exhibit 17, pages 61 and 62).

Q18. On pages 18 and 39 of its testimony, LES states that the laboratory measurements of the permeability of the Chinle are likely to be higher than *in situ* values because of deformation/fracturing caused by the sampling process. Do you agree?

A18. No. Although deformation and fracturing may occur, LES has not cited any information that indicates that deformed or fractured samples were tested in the laboratory. In fact,

laboratory measurements tend to be performed on the most uniform and intact samples available (NIRS/PC Exhibit 43, page 20).

Available data show that underestimates of permeability are much more common than overestimates (NIRS/PC testimony, page 10). Laboratory tests often underestimate actual permeabilities because the samples are not representative of larger-scale field conditions such as fractures (NIRS/PC Exhibit 25, page 131, Exhibit 43, pages 20 and 27, and Ehibit 17, pages 20 and 21). In addition, samples from fractured zones often are not recovered during coring (i.e., are not retained in the core barrel). When they are recovered, fractured samples often fall apart when removed from the barrel. There is no indication that LES or any other investigator attempted to measure the permeability of fractured zones in the laboratory.

Q19. On page 15 of its testimony, LES makes the following statement regarding the water bearing zones in the Dockum: "*Indeed, WCS investigators have concluded that the very large hydraulic head differences associated with these units indicates a lack of hydraulic communication in the Triassic Dockum Group in the site area.*" Do you agree?

A19. No. Groundwater may flow between units with very large hydraulic head differences.

Q20. On page 29 of its testimony, LES states that the pesticide detected in MW-2 probably did not reach the Chinle via a fast flow path. Do you agree?

A20. Yes, although my explanation of the pesticide detection differs from LES's (NIRS/PC Exhibit 17, pages 55 and 56).

I believe the pesticide detection was probably caused by contaminated surface soils that were introduced into MW-2 as it was drilled. Some soil samples taken at the site contained the same pesticide found in MW-2 (NIRS/PC Exhibit 28, analyses of soil samples).

Q21. On pages 31 and 32 of its testimony, LES states the saturated zones found at Wallach Quarry are intermittent. Is this consistent with LES's previous statements?

A21. No. According to LES exhibit 1, page 3.4-2, there is a perennial seep at the Wallach quarry.

Q22. On page 34 of its testimony, LES states that the water in the Santa Rosa Aquifer is old, having been recharged more than 15,000 years ago. Do you agree?

A22. I agree that the bulk of the water in the Santa Rosa Aquifer is old. However, if some water recharges the aquifer along fast flow paths such as fractures, a component of the water in the aquifer would be young. The presence of young water would be indicated by the presence of post-bomb tritium or chlorine-36. A component of young water would indicate that the aquifer is vulnerable to contamination from leakage originating at the proposed NEF.

According to the paper cited by LES (LES Exhibit 6) (NIRS/PC Exhibit 9), the estimates of groundwater ages for the Santa Rosa are not based on any data from the vicinity of the site. As the authors (Dutton and Simpkins) state: " ... *data coverage in the Dockum*

Group beneath the Southern High Plains is poor." (LES Exhibit 6, page 10) (NIRS/PC Exhibit 9). The paper contains no tritium or chlorine-36 data from the Santa Rosa.

A later paper by Dutton does contain tritium data from four wells in the lower Dockum (Santa Rosa?) (NIRS/PC Exhibit 8). These data indicate that the Dockum water does not contain a significant component of young water. However, the closest tritium measurement is from a well more than 100 miles from the proposed site (NIRS/PC Exhibit 8, pages 222, 225, and 227). Thus, these data are not directly applicable to the NEF site.

The bulk of the water in the Santa Rosa Aquifer at the site is probably quite old. The question is, however, whether it contains a young component. There are no data from the site, or even from within 100 miles of the site, that would answer this question. LES should be required to determine whether the groundwater in the Santa Rosa contains a component of relatively young water that would indicate recharge via fast flow paths. This could be done by collecting tritium and chlorine-36 samples from wells at the proposed site.

Q23. On pages 33 and 44 of its testimony, LES states that gravel is not consistently present through the site. Do you agree?

A23. Yes. However, with respect to flow paths beneath the site, the issue is not whether gravel is 'consistently present'. The issue is whether continuous zones of gravel extend beneath

and beyond the site. Such zones could act as fast flow paths for leakage that ponds on the alluvial/Chinle interface.

The alluvial materials beneath the site are stream-laid deposits - mixtures of sand, gravel, silt, and clay. Some zones within the alluvium are overbank deposits. These consist primarily of fine-grained materials (silt and clay). Other zones are channel deposits. These consist primarily of coarse-grained materials (sand and gravel). These channel deposits may extend for miles. Channel deposits should be considered when assessing the flow rate of leakage that may pond on the alluvial/Chinle interface.

Regarding the hydraulic properties of these deposits, LES states: "*Mr. Rice's choice of hydraulic conductivity is an attempt to demonstrate a potential maximum flow rate for ground water traveling along the surface of the red beds, ...* " (LES testimony, page 44). This is incorrect. The hydraulic conductivity I chose, 0.1 cm/s, is conservative. It is the lowest value in the range of values reported in my source (NIRS/PC Exhibit 14, page 29; range for gravel = 0.1 – 100 cm/s).

Q24. On page 14 of its testimony, LES mentions a 100-foot thick water-bearing layer at a depth of approximately 600 feet. Does LES know whether this layer exists beneath the NEF site?

A24. No. LES should be required to answer basic questions about this layer: 1) Does it exist below the proposed site? 2) How much water can it produce? 3) What is the quality of the

water? 4) What is the groundwater flow direction? These questions could be answered by conducting exploratory drilling, and if the layer exists, installing monitor wells.

It should be noted that all groundwater beneath the proposed site is subject to protection by the State of New Mexico (NIRS/PC Exhibit 35, page 2).

Q25. On page 14 of its testimony, LES mentions the Santa Rosa Formation. Has LES investigated this formation at the NEF site?

A25. No. The Santa Rosa Aquifer is used as a source of domestic and livestock water (NIRS/PC testimony, page 4). However, LES does not know answers to basic questions about the Santa Rosa at the proposed site: How much water can it produce? What is the quality of the water? What is the groundwater flow direction and flow rate? Where are the closest downgradient users? (NIRS/PC Exhibit 17, pages 57 and 58). These questions could be answered by installing monitor wells in The Santa Rosa, and by conducting a survey of water use in the area.

Q26: On page 35 of its testimony, LES states that " ... *releases from the Wallach Quarry and the Sundance Services "produced water" lagoons north of the NEF site would be readily differentiated from potential releases from the NEF site.*" Does LES offer any information to support this statement?

A26. No.

Q27: On page 35 of its testimony, LES states that the Lea County landfill is downgradient of the proposed site. Do you agree?

A27: I agree in part. It is true that the landfill is downgradient of the site with respect to the groundwater system in the Chinle. However, the landfill appears to be upgradient of the site with respect to any water flowing along the alluvial/Chinle contact. As explained by NRC, perched groundwater flowing along the contact would flow down the slope of the contact (NRC testimony, page 21). According to the limited information available, the alluvial/Chinle contact appears to slope from the landfill toward the site (NIRS/PC Exhibit 4, figure 4). If this is true, then the landfill is upgradient of the site with respect to water flowing along the contact.

Q28: On page 54 of its testimony, LES refers to your testimony as a "parade of horribles". Is this a reasonable characterization of your testimony?

A28: No. My testimony shows that LES has not answered a host of fundamental questions regarding the hydrology of the proposed site and the operation of the NEF. From LES's point of view, the answers to these questions may be pleasant or horrible.

Q29. Have you reviewed NRC's testimony regarding EC-1?

A29. Yes.

Q30. Do you have a general opinion of the testimony?

A30. Yes. I disagree with a number of NRC's assertions regarding EC-1. Some of NRC's testimony is based on insufficient information. Some of NRC's testimony is incorrect.

Much of the information that rebuts NRC's testimony is contained in my prefiled testimony. As with the LES testimony, I will reference most of this testimony, rather than repeating it.

Q31. In its testimony on pages 8, 10, and 12, NRC claims that the closest possible discharge location for leakage emanating from proposed NEF is Monument Draw. NRC also claims that Monument Draw is not used due to its intermittent flow. Do you agree?

A31. Monument Draw may be the closest existing discharge location, although neither NRC nor LES appear to have performed a field search for potential discharge locations (NIRS/PC testimony, page 16).

Regarding the use of Monument Draw, it is true that it flows only intermittently. However, surface water is not the primary concern. Groundwater in the alluvium along the Draw has been used as a source of domestic supply (NIRS/PC testimony, page 5). This source is within two miles of the proposed site (NIRS/PC Exhibit 37, plate 2).

Based on the limited information available, Monument Draw appears to be hydraulically down gradient of any leakage that would flow from the NEF. The slope of the alluvial/Chinle contact is approximately 2% toward the south-southwest (NRC testimony,

page 9, and NIRS/PC Exhibit 4, page 8 and figure 4). According to NRC's estimate of the flow rate along the contact (252 m/yr, 0.16 mi/yr), leakage emanating from the NEF could travel over four miles in 30 years (NRC testimony, page 9). Of course, this leakage would continue flowing for some period after the NEF stopped operating.

Q32. On page 9 of its testimony, NRC presents an estimate of the groundwater flow rate along the alluvial/Chinle contact (252 m/yr, 0.16 mi/yr). Do you believe this is an appropriate estimate?

A32. No. When estimating the flow rate along the alluvial/Chinle contact, the properties of the more permeable materials underlying the site should be used. This will result in a conservative estimate of the distance that leakage from the NEF may travel.

NRC's estimate is based on literature values for the hydraulic conductivity and porosity of sand (NRC testimony, pages 8 and 9, and NRC Exhibit 6, table 5.1). I estimated flow rates based on literature values for the hydraulic conductivity and porosity of gravel (0.1 cm/s and 0.3, respectively, NIRS/PC Exhibit 14, pages 29 and 37). Gravels were found in most of the boreholes drilled at the site (NIRS/PC Exhibit 4, appendix A).

Using the values given above for gravel, and NRC's estimate of the hydraulic gradient for the contact (2%, NRC testimony, page 9), the flow rate for leakage flowing through gravels along the alluvial/Chinle contact is approximately 2100 m/yr (1.3 mi/yr).

Q33. On page 13 of its testimony, NRC states that an attempt to estimate leakage rates from the lined basins " *... would have little or no meaning, and in fact could be very misleading.*" Do you agree?

A33. No. Estimates of leakage rates from lined facilities such as basins and landfills are routinely performed. The EPA has developed computerized models to estimate these rates (e.g., HELP, EPACMTP, NIRS/PC Exhibits 10 and 12). LES/NRC should be required to estimate leakage rates from the lined basins.

Q34. On page 19 of its testimony, NRC states that the moisture found in boring B-9 represents precipitation that that infiltrated into the shallow subsurface (6 – 14 feet). Do you agree?

A34. Yes. However, I disagree with NRC on the fate of the infiltrated precipitation. NRC believes the infiltrated precipitation will be removed by evapotranspiration (NRC testimony, page 19). I believe that a portion of the infiltrated precipitation probably makes its way to the alluvial/Chinle contact and flows along the contact. That is, the moisture found in boreholes at the NEF site, and at the WCS site, is an indication of episodic recharge (NIRS/PC testimony, page 7).

My interpretation is supported by the moist clay found in boring B-2 at the alluvial/Chinle contact (depth = 35 feet, NIRS/PC testimony, page 6). Moist clay at the alluvial/Chinle contact also occurs at the WCS site. In a study conducted by Holt, moist clay was found in 16 of 25 borings that penetrated the contact (NIRS/PC testimony, page 7). The depth of the moist clay at WCS ranged from 19 to 37 feet (NIRS/PC Exhibit 19,

records of borings). The moist clay in boring B-2, and in the borings at the WCS site, is likely the result of recharge that ponded along the interface between the alluvial materials and the relatively impermeable Chinle. The clay retains water longer than the overlying alluvium.

NRC does not offer an explanation for the moisture in the clay at the alluvial/Chinle contact. It merely refers to the moist clay as an isolated observation (NRC testimony, page 19).

Q35. On pages 22 and 23 of its testimony, NRC contends that the permeability measurements performed at the proposed site (a slug test), and at the WCS site (laboratory measurements on core samples), constitute an adequate assessment of permeability at the NEF site. Do you agree?

A35. No. As explained in my testimony, slug tests and laboratory measurements on cores are not likely to measure the permeability of fractures that may be present (NIRS/PC testimony, page 10).

There is no indication that any investigator attempted to measure the permeability of fractured zones at the NEF site or the WCS site. This is a significant oversight, as fractures may be the pathways through which leakage from the NEF would flow to water bearing units in the Chinle Formation or the Santa Rosa Aquifer.

According to NRC, fractures that may act as fast flow paths probably do not exist at the proposed site. This conclusion is based, in part, on the notion that any fractures caused by faulting at the WCS site (see below) would be closed (NRC testimony, page 24). However, this is not consistent with the data obtained by Holt. Holt found evidence of water movement through fractures at the WCS site (NIRS/PC testimony, page 9).

The question of the existence of fractures could be resolved by carefully collecting and examining cores from the proposed site, as Holt did at the WCS site. If no fractures capable of acting as preferred flow paths are found, then the question would be settled. However, if such fractures are found, then LES/NRC should be required to estimate the rate at which the fractures would transmit leakage from the NEF to underlying groundwater systems.

It should be noted that all of the groundwater beneath the proposed site is subject to protection by the State of New Mexico (NIRS/PC Exhibit 35, page 2).

Q36. On page 23 of its testimony, NRC mentions faults that were recently discovered in the Chinle Formation (Triassic Red Beds) at the WCS site. NRC states that an evaluation of the faults found no evidence of fast flow paths. This is attributed to healing of the fractures. Do you agree with this interpretation?

A36. No. Holt found evidence of water movement through fractures at the WCS site. His borings logs report fractures that have healed, as well as fractures with mineral deposits.

The mineral deposits indicate that the fractures have acted as groundwater flow paths (NIRS/PC testimony, page 9).

In addition, LES and NRC do not appear to have investigated the potential effects of these faults on the proposed site. They should determine whether the faults at the WCS site extend toward or beneath the NEF site. A memo from G.L. Environmental Inc. to LES indicates that a fault exists beneath the proposed site. The memo asks: " ... *will information on the fault under NEF be provided?"* (NIRS/PC Exhibit 15). LES's hydrologist has stated that, when investigating a site, he would wish to know whether a fault was present (NIRS/PC Exhibit 17, pages 100 and 101).

Q37. On page 25 of its testimony, NRC appears to claim that the analyses listed in DEIS table 6-9 are sufficient to monitor the concentrations of fuels in stormwater runoff. Do you agree?

A37. No. The only analysis in DEIS table 6-9 that might directly detect the presence of fuel components is 'Oil and Grease'. However, the detection limit for the Oil and Grease analysis is 0.5 ppm, while the human health standard for the fuel component benzene is 0.01 ppm (NIRS/PC Exhibit 36, page 12). Therefore, the analyses listed in DEIS table 6-9 are not sufficient to monitor fuels in stormwater runoff.

Q38. On page 27 of its testimony, NRC's claims that BOD (biological oxygen demand[3]) and COD (chemical oxygen demand) analyses would detect the presence of PAHs, aliphatic hydrocarbons, and alcohols. Do you agree?

A38. No. These analyses do not detect the presence of individual contaminants. Instead, they are gross measures of the amount of organic matter in water, as indicated by changes in the concentration of oxygen or some other oxidant (NIRS/PC Exhibit 16, page 3).

Furthermore, the detection limits proposed for BOD and COD are 2 mg/L and 1 mg/L, respectively (NRC Exhibit 1, table 6-9). However, the drinking water standards for some PAHs[4] are much lower that these detection limits. For example, the human health standard for benzo-a-pyrene is 0.0007 mg/L (NIRS/PC Exhibit 36, page 12). Thus, even if PAHs could be detected by BOD or COD analyses, some of them would only be detected once their concentrations exceeded standards by a factor of more than 1000.

Q39. Does this conclude your testimony?

A39. Yes.

[3] Also known as biochemical oxygen demand (NIRS/PC exhibit B).
[4] PAHs are a group of chemicals that includes: acenaphthylene, benzo-a-pyrene, fluoranthene, naphthalene, and other compounds (NIRS/PC exhibit 41, page 21).

CERTIFICATE OF SERVICE

Pursuant to 10 CFR § 2.305 the undersigned attorney of record certifies that on January 28, 2005, the foregoing Rebuttal Testimony of George Rice on behalf of Nuclear Information and Resource Service and Public Citizen, NIRS/PC Contention EC-1, was served by electronic mail and by first class mail upon the following:

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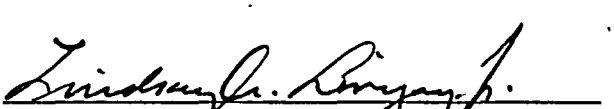

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