RAI-1:

Clarify the current status of WDW-156, the deep disposal well at the Lamprecht site, including confirmation that the well was plugged and abandoned, and the Underground Injection Control (UIC) permit conditions were satisfied.

TCEQ Response to RAI-1:

TCEQ has located a letter from Texas Natural Resource Conservation Commission (TNRCC) to Intercontinental Energy Corporation (IEC) dated June 29, 1998, containing a "Revocation of Permit No. WDW-156" (TNRCC – 1998). The letter states that "the activities authorized by the permit have ceased and WDW-156 is plugged and abandoned in accordance with IEC's WDW-156 Closure Report and in accordance with 30 TAC §331.46 as confirmed by an inspection of the site by the staff of the TNRCC". The revocation of Permit No. WDW-156 implies that the Underground Injection Control permit conditions were satisfied.

RAI-2:

Please provide the requested technical documentation summarizing the State's decision-making process related to the completion of the groundwater restoration at both the Lamprecht and Zamzow sites.

TCEQ Response to RAI-2:

Lamprecht: UIC permit UR01949

IEC began the restoration of groundwater at the Lamprecht site in 1988. Groundwater restoration through the methods of groundwater sweep and reverse osmosis were conducted from 1988 until 1993. A total of over eight "pore volumes" were flushed through the subsurface. IEC filed a request to amend the restoration table values for seven groundwater parameters in their UIC permit and the amended permit was granted in June 1992. Groundwater restoration ended in December 1993, after which a 180-day stabilization period began, which included the collection of three sets of stabilization samples. In September 1994, TNRCC declared the restoration complete. The following paragraphs will further expand on this series of events.

The most recent version of the underground injection permit, dated June 24, 1992, includes an amended restoration table, which lists the allowable concentrations of constituents of concern for restoration of groundwater (Texas Water Commission [TWC] – 1992a). The state's technical justification for authorizing the amended restoration table can be found in an Interoffice Memorandum (IOM) from the TWC, dated June 1, 1992 (TWC – 1992b). The technical justification for amending the restoration table values for seven parameters (bicarbonate, sulfate, chloride, conductivity, molybdenum, uranium and ammonia) above baseline values is outlined below.

According to 30 TAC 331.107(f)(2), the TWC could amend the restoration table if it finds that the following four criteria have been addressed:

(A) Reasonable restoration efforts have been undertaken: IEC used the best available technology to restore the groundwater at the site and pumped over 1.3 billion gallons of water through the aquifer since 1988.

(B) Water quality parameters have stabilized for a period of 180 days: Over eight pore volumes of water have been pumped through this mine zone, and data indicate that very little change in water quality occurred since the third pore volume.

(C) The water in the aquifer is suitable for any use it was suited for prior to mining: Baseline water quality at the site exceeded EPA drinking water standards in seven categories: sulfate, chloride, TDS, iron, manganese, selenium, and radium-226. Prior to mining, the water in this portion of the aquifer was suited only for stock or irrigation water. Amending the restoration table did not change the use category for this water.

(D) Further restoration efforts would consume energy, water, or other natural resources of the state without providing a corresponding benefit to the state: Restoration history has shown that certain water quality parameters such as ammonia have been very resistant to restoration back to baseline levels. Because of this fact, all in situ uranium mining companies ceased using ammonia by about 1982. At Lamprecht, however, ammonia had already been introduced in the system. Since ammonia in groundwater is not a health threat but rather an aesthetic (taste) problem, amending the ammonia value to the requested value would save time, energy, resources, and water necessary to pump an estimated 1.7 billion gallons of water necessary to reduce ammonia down to pre-mining levels.

Based on the justifications given above, staff recommended approval of the amendment to the permit. The amended values can be seen in Table 1, attached.

Following the approval of the amended permit and the conclusion of groundwater restoration, IEC submitted a *Restoration Stabilization Sampling Report* on July 21, 1994 (IEC – 1994). The report indicated that three sets of stability samples were collected in 1994, and that two TNRCC representatives were on site to observe and split samples during the collection of the third set of stability samples. IEC stated that the restoration had been achieved and that the aquifer was stable.

A review of the data presented in the report indicated that the average of the third stabilization sample set exceeded the restoration table values for radium-226, manganese, iron, arsenic, and alkalinity. Justification for why these exceedances were not cause for concern or requiring additional groundwater restoration efforts is given below and a table summarizing the information is attached, titled *Table 1: Lamprecht Restoration Table Values Compared to Third Set Stabilization Average Sample Results*.

Radium-226 was detected at an average concentration of 257 pCi/L during the third stabilization sampling, above the restoration table value of 218.3 pCi/L. However, the average from all three stability sample sets for radium-226 was 221.3 pCi/L, only slightly higher than the restoration table value, which is the value that was naturally occurring in baseline samples.

Manganese was detected at 0.157 mg/L in the third stabilization set, just slightly above the restoration table value of 0.121 mg/L. Only three of the 19 baseline wells tended to elevate the overall average of the third sample set.

Iron was detected in the third sample set at an average concentration of 2.425 mg/L, greater than the baseline value of 0.332 mg/L. The elevated iron concentration did not materially change the water classification as stock or irrigation water.

Arsenic was detected during the third stabilization sampling at a concentration of 0.074 mg/L, above the restoration table value of 0.013 mg/L. The report references the drinking water standard for arsenic as 0.05 mg/L, and the average from all three stability sets as 0.053 mg/L, just above the referenced drinking water standard. The elevated arsenic level does not change the water use class in that the pre-mining water quality could not meet the drinking water standard for sulfate, chloride, TDS, iron, manganese, selenium, and radium-226. The current average arsenic level meets the standards set for livestock and other agricultural uses such as irrigation.

Alkalinity is the last constituent of concern, with an average concentration of 481 mg/L in the third set of stability samples, higher than the restoration table value of 276 mg/L. Alkalinity is associated with the calcium environment of the Lamprecht mine formation and does not have a Primary Drinking Water Standard. In terms of agriculture, elevated alkalinity could damage plants by changing the proportion of sodium to magnesium and calcium in the soils. Generally, for this to occur, alkalinity would have to be more than 600 mg/L. The current level does not change the water use classification.

The state accepted the results presented in the *Restoration Stabilization Sampling Report* and approved groundwater restoration in a letter dated September 16, 1994 (TNRCC – 1994). The letter states that the TNRCC received the restoration data for Production Area 1 of the Lamprecht Site, and a review of the data indicated that the production area was restored in accordance with the specifications contained in permit UR01949-011 and as required by 30 TAC §331.107. The letter authorized IEC to cease restoration activities, including monitoring, at the production area. The letter also authorized the plugging and abandonment of the wells at the site. A review of Permit No. UR01949-011 indicates that Production Area No. 1 includes all monitoring wells located around the perimeter of the north and south areas of the Lamprecht Mine, thus incorporating the entire site. Previously designated Production Areas No. 1, 2, 3, and 4 were combined into one production area in 1988 at the beginning of groundwater restoration under Permit No. UR01949-011.

The state approved the restoration of groundwater at the Lamprecht site in September 1994, after approving the amendment of the restoration table values in the permit in June 1992 and approving the results of the third set of stabilization samples submitted in July 1994. All production and monitoring wells were plugged and abandoned by 1996.

Zamzow: UIC permit UR02108

Groundwater restoration at the Zamzow site took place from 1986 until 1995 using groundwater sweep and reverse osmosis. After groundwater restoration concluded, a 180-day stabilization period began, including the collection of three rounds of stabilization samples. In June 1997, an amended permit was approved with amended restoration table values. Finally, in July 1997, TNRCC approved the groundwater restoration at the Zamzow site.

The most recent version of the permit, dated June 27, 1997, includes the amended restoration table, which lists the allowable concentrations of constituents of concern for groundwater restoration (TNRCC – 1997a). In an IOM from the TNRCC UIC Permitting Team, staff recommended the approval of the amended restoration values (TNRCC – 1996). The amendment changed the restoration table values for nine constituents (sodium, bicarbonate, pH, alkalinity, arsenic, ammonia, uranium,

molybdenum, and radium-226). The changes to the restoration table values are as follows:

Parameter	Baseline Value	Amended Value	Unit
Sodium	387	450	mg/L
Bicarbonate	582	750	mg/L
pH	7.0	6.5 - 8.5	standard units
Alkalinity	275	500	mg/L
Arsenic	0.009	0.2	mg/L
Ammonia	0.374	200	mg/L
Uranium	0.2	3	mg/L
Molybdenum	0.2	5	mg/L
Radium-226	155	200	pCi/L

The justification for the increase in the restoration table values above baseline was that prior to mining, the water in the production area was used for livestock and that the proposed values would not change the use category of the water. The average water quality present before mining exceeded TNRCC and EPA primary drinking water standards for radium-226 and secondary standards for sulfate, chloride, iron, and manganese. Further analysis concluded that IEC met the following criteria set forth in 30 TAC §331.107(f)(2) for an amendment to restoration table values:

a) reasonable efforts were undertaken by the company to restore the aquifer;

b) water quality parameters have been stabilized for over 180 days;

c) the formation water in the aquifer is suitable for any use to which it was suitable prior to mining; and

d) further restoration efforts would consume energy, water, or other natural resources of the state without providing a corresponding benefit to the state.

A review of the *Third Stability Sample Analyses* report submitted by IEC to TNRCC for the Zamzow Mine (IEC – 1995) indicates that all the analyses for the three stability sample sets confirmed that the Zamzow Mine's aquifer had been restored and the water quality was stable. All stability set samples were below the amended restoration table values. The state approved groundwater restoration in a letter dated July 8, 1997. This letter states that Production Area No. 1 of the Zamzow Mine was restored in accordance with the specifications contained in the permit and as required by 30 TAC §331.107 (TNRCC – 1997b). A review of Permit No. UR02108-011 indicates that Production Area No. 1 includes all monitoring wells located around the perimeter of the Zamzow Mine. Previously designated Production Areas No. 1, 2, 3, and 4 were combined into one production area in 1988.

The state approved the restoration of groundwater at the Zamzow site in July 1997, after approving the amendment of the restoration table values in the permit in June 1997 and approving the results of the third set of stabilization samples submitted in

October 1995. All production and monitoring wells were plugged and abandoned by 1997.

References:

Intercontinental Energy Corporation – 1994. TWC Permit No. UR 01949 (Lamprecht Mine) – Restoration Stabilization Sampling – Third Set, dated July 21, 1994. Submitted to TNRCC.

IEC – 1995. TWC Permit No. UR 02108 (Zamzow Mine) – Third Stability Sample Analyses, dated October 13, 1995. Submitted to TNRCC.

Texas Department of Health – 1992. Letter from the Bureau of Radiation Control to the Texas Water Commission regarding appropriate limits for radium-226 and uranium in groundwater, letter dated May 6, 1992.

TNRCC – 1994. Restoration determination of Production Area No. 1 of the Lamprecht Mine Site, Permit No. UR01949-011, dated September 16, 1994. Issued to IEC.

TNRCC – 1996. Interoffice Memorandum regarding the Transmittal of Application of IEC UR02108-011, dated December 4, 1996.

TNRCC – 1997a. Authorization to conduct underground injection under provisions of Permit No. UR02108-011, dated June 27, 1997. Issued to IEC.

TNRCC – 1997b. Restoration Determination for Production Area 1, UR02108-011, Zamzow Mine, dated July 8, 1997. Issued to IEC.

Texas Natural Resource Conservation Commission (TNRCC) – 1998. Revocation of Permit No. WDW-156, dated June 29, 1998. Issued to Intercontinental Energy Corporation.

Texas Water Commission (TWC) – 1992a. Authorization to conduct underground injection under provisions of Permit No. UR01949-011, dated June 24, 1992. Issued to IEC.

TWC – 1992b. Interoffice Memorandum regarding Permit No. UR01949-011, dated June 1, 1992.