RAI 15.A:

Description of Deficiency: The information provided in TR does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 3.1.2 and acceptance criteria in Section 3.1.3 of NUREG 1569.

Basis for Request: In accordance with NUREG 1569, Section 3.1.3 Criterion (5)(f), the application did not provide an acceptable analysis of the ground water hydraulic effects of nearby agricultural wells. Specifically,

Considering the possible occurrence of regulated material releases to the overlying aquifer (e.g., from a potential surface spill or a potential well casing failure) within the MEA, the application does not provide an analysis of the possible ground water hydraulic effects that nearby agricultural wells (well locations are shown in TR Figure 2.7-6 as indicated by TR Table 2.2-11 and TR Appendix A) may have on the migration of potential MEA regulated material releases in the overlying ground water zone toward these wells. Thus, staff cannot confirm whether the applicant's monitoring, containment, corrective action programs for potential MEA regulated material releases into the overlying aquifer will be protective of the agricultural wells and other private wells (located between MEA operations and the agricultural wells).

Request for Addition Information: Please provide an analysis of the hydraulic effects that nearby agricultural wells may have on the migration of potential MEA regulated material releases in the overlying ground water zone toward these wells. This analysis should further define the hydrostratigraphy within the Arikaree and Brule formations and should be centered on the protection of agricultural wells and other private wells (located between MEA operations and the agricultural wells) from potential MEA regulated material releases to the overlying aquifer. Results of this analysis should be used to demonstrate the effectiveness of the applicant's proposed monitoring, containment, and corrective action programs for addressing possible MEA regulated material releases into the overlying groundwater zone."

RAI 15.A Response (02/27/2015):

A new appendix, Appendix FF-3, has been added to include the report from AquiferTek that summarizes the data collected during the 2014 irrigation season and provides an analysis of the impact from the potential hydraulic effect of the nearby agricultural wells.

Section 2.9.3.2 has been revised to include a reference to Appendix FF-3 and a summary of the data collected during the 2014 irrigation season.

2.9.3.2 CBR Groundwater Monitor Wells

- Arikaree Group and Brule Formation

Ten Arikaree Group monitoring wells (AOW-1, AOW-3 through AOW-11) were installed in 2013. There are 11 active monitoring wells screened in the Brule Formation (BOW-2010-1, BOW-2010-2, BOW-2010-3, BOW-2010-4A, BOW-2010-5, BOW-2010-6, BOW-2010-7, BOW-2010-8, BOW-~~2013~~-9, BOW-~~2013~~-10 and BOW-~~2013~~-11). Three of these wells (BOW-~~2013~~-9, BOW-~~2013~~-10, and BOW-~~2013~~-11) were screened in the ~~Arikaree Group~~Brule Formation in September 2013. The Walters Drillers Pond-720 (Walters-2) and Walters Drillers Pond-721 (Walters-1) wells have been employed as monitoring wells for the Brule Formation, but these wells will not be part of future monitoring, specifically for the Brule Formation, because these wells are screened across the Arikaree and Brule Formations. In September 2013, ten wells were screened in the Ari~~a~~karee Group. The primary purpose of the Arikaree and Brule monitor wells is to further the site-specific understanding of the hydrologic characteristics of the Arikaree Group and Brule Formation. Installation and subsequent monitoring of water levels and water quality is intended to provide more information about potentiometric surfaces of groundwater within aquifers and provide data by which the hydrologic connectivity between the aquifers, or lack thereof, can be determined. The locations of CBR's Arikaree and Brule monitor wells within the MEA are shown on **Figure 2.7-8**.

Well BOW-2010-4 is not being used for baseline monitoring, and plans are to abandon this well in the future. During reaming of this well for casing, the driller lost a bit that he was unable to retrieve. Unsuccessful attempts made to convert the well to a shallow monitor well resulted in the well being considered unacceptable for baseline monitoring. A new replacement well (BOW-2010-4A) was drilled nearby. Well completion records for these monitoring wells are included in **Appendix E-2.**

Thirteen active monitoring wells are screened in the basal sandstone of the Chadron Formation (CPW-2010-1, CPW-2010-1A, Monitor-1, Monitor-2, Monitor-3, Monitor-4A, Monitor-5, Monitor-6, Monitor-7, Monitor-8, Monitor-9, Monitor-10, and Monitor-11; **Figures 2.7-6** and **2.7-9**). Well completion reports for these monitoring wells are included in **Appendix E-2**.

In 2013, a sampling program was implemented for all MEA Arikaree, Brule and Chadron wells to monitor water level changes to those aquifers over a one year time span to determine what effect, if any, seasonal flow, annual variation, or nearby irrigation wells may have upon the observed groundwater movement. Water level data has been collected in October 2013, January 2014, April 2014, and July 2014 and is presented in **Appendix FF-1.** Potentiometric surface maps for the three aquifers for each sampling period are shown on **Figures 2.9-4a through 2.9-4d, 2.9-5a through 2.9-5d, and 2.9-6a through 2.9-6d.**

Static water levels measured for the Arikaree Group monitoring wells range from 19 to 142 feet below the top of the well casing (btoc). Calculated groundwater elevations ranged from approximately 4,049 to 4,294 feet amsl. The potentiometric surface maps **(Figures 2.9-4a through 2.9-4d)** indicate that groundwater flow within the Arikaree Group is to the south-southeast toward the Niobrara River at an average lateral hydraulic gradient of approximately 0.009 ft/ft.

Static water level for wells screened in the Brule Formation in the vicinity of the MEA typically range from approximately 37 to 156 feet btoc. Groundwater elevations measured during the sampling events ranged from approximately 4,050 to 4,296 feet amsl. Potentiometric surface maps indicate groundwater in the Brule Formation flows predominantly to the south-southeast across the entire MEA toward the Niobrara River drainage at a lateral hydraulic gradient of 0.011 ft/ft **Figures 2.9-5a through 2.9-5d** (Aqui-Ver 2011). Regional water level information for the Brule Formation is currently only available in the vicinity of the current production facility.

~~Water levels were measured for the Arikaree Group at 10 monitoring wells on October 17, 2013 (**Table 2.9-7**). The static water level for wells screened in the Arikaree Group ranged from 19 to 149 feet bgs. Calculated groundwater elevations ranged from approximately 4,049 to 4,293 feet amsl. A potentiometric surface map and groundwater flow directions for the October 17, 2013 event are depicted on **Figure 2.9-4**. Groundwater level data collected in October 2013 indicate that groundwater flow within the Arikaree Group is to the south-southeast toward the Niobrara River at an average lateral hydraulic gradient of approximately 0.009 ft/ft.~~

~~In addition to the water level measurements for 11 monitoring wells on October 17, 2013, water levels were also measured for the Brule Formation at six monitoring wells on February 22, 2011 and nine monitoring wells on October 17, 2013 (**Table 2-9-7**). The static water level for wells screened in the Brule Formation in the vicinity of the MEA typically ranges from approximately 37 to 155 feet btoc. Groundwater elevations measured during the two measurement events ranged from approximately 4,050 to 4,295 feet amsl. Potentiometric surface maps and groundwater flow directions for October 17, 2013 and February 22,2011events are depicted on **Figure 2.9-5a and 2.9-5b**. Groundwater in the Brule Formation flows predominantly to the south-southeast across the entire MEA toward the Niobrara River drainage at a lateral hydraulic gradient of 0.011 ft/ft (Aqui-Ver 2011). Regional water level information for the Brule Formation is currently only available in the vicinity of the current production facility.~~

As shown in **Figures 2.9-4a** and **2.9-5a**, October 2013 groundwater level data for the Arikaree Group and Brule Formation indicate potentiometric surfaces that are nearly equal in elevation. Particular care was taken during installation of monitoring wells to avoid screening individual wells within both the Arikaree and Brule. Although the wells are screened at different intervals, nearby pairs of monitoring wells screened in the two units demonstrate groundwater elevations with differences of approximately 5 feet or less. While some minor variation exists between the two potentiometric surfaces, the similarity in groundwater elevations and shared south-southeast groundwater flow direction indicates significant hydraulic connectivity between the Arikaree Group and Brule Formation within the MEA. The shared hydraulic head between the two geologic units likely indicates that groundwater within the Brule Formation is not confined by overlying units, and the Arikaree Group and Brule Formation function as a single hydrogeologic unit.

Basal Sandstone of the Chadron Formation

Water levels for the basal sandstone of the Chadron Formation were measured at 13 sites in October 2013, January 2014, April 2014, July 2014 (Appendix FF-1). The static water level for wells screened in the basal sandstone of the Chadron Formation in the vicinity of the MEA typically ranges from approximately 399 to 680 feet bgs. Groundwater elevations measured during the measurement events ranged from approximately 3,687 to 3,704 feet amsl. Potentiometric surface maps and groundwater flow directions for the sampling events are depicted on **Figures 2.9-6a through 2.9-6d**. Groundwater in the basal sandstone of the Chadron Formation flows predominantly to the northwest toward the White River drainage at a lateral hydraulic gradient of 0.0004 ft/ft (Aqui-Ver 2011). It does not appear, based on the four consecutive quarterly measurements that there are seasonal or annual changes in the groundwater flow. Regional water level information for the basal sandstone of the Chadron Formation is currently only available in the vicinity of the current production facility.

- Risk Conclusions

Strong vertically downward gradients exist at all locations within the MEA, indicating minimal, if any, risk for potential impacts to the Arikaree Group and Brule Formation from the underlying basal sandstone of the Chadron Formation under natural conditions. Observed head differences between the two water-bearing zones at six well pairs (BOW-2010-1 and Monitor-3, BOW-2010-2 and Monitor-4A, BOW-2010-3 and Monitor-8, BOW-2010-4 and Monitor-10, BOW-2010-5 and Monitor-11, and BOW-2010-6 and Monitor-1) ranged from approximately 346 to 518 feet during the October 2013 measurement event.

Available groundwater data for the Arikaree Group and Brule Formation and basal sandstone of the Chadron Formation at the MEA do not indicate any documented flow rate variations or recharge issues that would impact groundwater quality as a result of ISR recovery operations in the basal sandstone of the Chadron Formation. There are no surface water ponds within the MEA license boundary and only limited, intermittent flow in ephemeral drainages. The Arikaree Group and Brule Formation, while considered to be overlying aquifers, are not exceptionally productive in the MEA area.

The presence of high-capacity irrigation wells both within and near the MEA screened within the Arikaree Group and Brule Formation will have a seasonal impact on those aquifers. Agricultural wells near MEA are primarily used for irrigation water between mid-May and early August, with lesser volumes of water extraction lasting into September. These wells are metered, but data are only collected annually; therefore, daily, weekly, and monthly extraction rates are unavailable. Estimated flow rates for wells provided by well users are provided in **Appendix A**.

Water level elevation data was collected from eight shallow monitoring wells (AOW-4, AOW-5, AOW-9, AOW-10, BOW-2010-4A, BOW-2010-5, BOW-9, and BOW-10) at the MEA from December 11, 2013 to October 9, 2014. Water level data were collected using downhole in-situ Troll® dataloggers equipped with pressure transducers. Water levels were collected once per day from each monitoring well over the monitoring period, and are plotted in **Appendix FF-3** (AquiferTek, Nov. 2014).

Results of water level monitoring indicate the operation of irrigation well 732 caused a maximum of 2.2 feet of drawdown in the nearest monitoring well cluster (AOW-9/BOW-9) over a 100-day (3.3 month) irrigation well pumping period. Drawdown in other shallow monitoring wells was not significant and less than 0.5 feet. Drawdown measured in AOW-9 and BOW-9 was very similar, indicating the shallow Arikaree and Brule aquifers are in hydraulic communication as previously noted in the Aqui-Ver, Inc. Report December 2013 (Aqui-Ver, 2013) (**Appendix FF-2**).

The data collected during the 2014 irrigation season indicates irrigation well 732 pumped 57,742,980 gallons of groundwater over an approximate 100-day (3.3 month) period from late April to early August 2014. This equates to an average continuous pumping rate of 401 gpm over pumping rate of 401 gpm over the 3.3 month operating period. Because the actual operating pumping rate of well 732 is approximately 800 gpm, we can infer well 732 pumped at a rate of 800 gpm for 12 hours each day during operating period. The observed 2014 irrigation operating conditions differed somewhat from the estimated operating conditions used in the impact analysis (Aqui-Ver, 2013) (well 732 operating 11 hours per day for 5-months, or an average continuous pumping rate of 373 gpm).

The groundwater flow model used in the original December 2013 impact analysis was calibrated by simulating observed changes in water level elevation (drawdown) in shallow monitoring wells AOW-9/BOW-9 during the 2014 irrigation season using the updated irrigation well 732 operating conditions (Aqui-Ver, 2013).

Aquifer parameters used in the "high transmissivity scenario" of the December 2013 irrigation well impact analysis were used as initial conditions for the model calibration. In order to calibrate the flow model and achieve a reasonable match between observed and simulated drawdown, the specific yield of the shallow Arikaree/Brule aquifer was lowered slightly from 0.1 to 0.048. A summary of calibrated flow model parameters and irrigation well operating conditions is summarized below:

Hydraulic conductivity - 8.2 ft/day.
Transmissivity - 1656 ft2/day (aquifer thickness 202 feet).
The hydraulic gradient – 0.004.
Porosity – 0.15
Specific Yield – 0.048 (adjusted downward from 0.1 to calibrate the model)
Pumping rate – 401 gpm for 3.3 months (100 days).

Results of the flow model calibration are shown in the AquiferTek Report in **Appendix FF-3**. Observed and simulated drawdowns in wells AOW-9/BOW-9 are very similar, and simulated drawdown in other shallow monitoring wells is less than 0.5 feet as observed. Given these results, the model has been adequately calibrated and can be used to make predictions with a reasonable degree of accuracy.

The calibrated groundwater flow model was used to calculate the 30-year capture zone of irrigation well 732. Particle-tracking techniques were used to illustrate the 30-year capture zone of irrigation well 732 to assess whether a hypothetical shallow casing leak from the MEA wellfields could potentially impact the irrigation well.

For purposes of this analysis, a conservative (worse-case) scenario was assumed in which irrigation well 732 pumps the maximum allowable amount of groundwater (251 acre-ft/year, 373 gpm for 5-months) and a hypothetical shallow casing leak occurs at some time along the downgradient portion of the adjacent wellfields at the MEA. These are the same operating conditions assumed in the original December 2013 impact analysis, which are considered to be more conservative than conditions observed during the 2014 growing season (e.g. 3.3 month operating period, 70% of permitted water right).

The revised 30-year capture zone of irrigation well 732 is illustrated in **Appendix FF-3**. Based on the results of this analysis, MEA wellfields are not located within the capture zone of irrigation well 732. A shallow casing leak within the MEA wellfields will not impact irrigation well 732 at any time in the future given similar operating conditions. This conclusion is identical to the original December 2013 impact analysis **Appendix FF-2**.

Given the location of other irrigation and domestic wells in the area and configuration of the worse-case capture zone, it is reasonable to conclude there are no other wells outside the MEA boundary that will be impacted by a potential release of MEA regulated material to the shallow aquifer. Therefore, the current MEA shallow groundwater monitoring network is adequate to ensure the protection of human health and environment.
CBR has installed additional monitoring wells within the Arikaree Group and Brule Formation located between the anticipated wellfield and the irrigation wells. The monitoring wells will be sampled seasonally to establish baseline data for both water quality and water levels. The fourth consecutive quarterly monitoring event will be completed in the summer of 2014. This sampling will allow for a full assessment of the impacts that the irrigation wells may have upon those aquifers within the MEA. **Figure 2.7-8** shows the locations of the Arikaree Group and Brule Formation monitoring wells.

Pumping test data show that the basal sandstone of the Chadron Formation is hydraulically isolated from the overlying Arikaree Group and Brule Formation aquifers due to the presence of several hundred feet of claystones, mudstones, and siltstones of the upper Chadron Formation and middle Chadron Formation. Estimated hydraulic conductivity data based on particle size distribution analysis of core samples from the upper confining zone discussed in Section 2.7.2.2 support the effectiveness of these confining units indicated by the pumping test. No agricultural wells are completed in the basal sandstone of the Chadron Formation. Groundwater extraction by agricultural wells completed in the Arikaree Group or Brule Formation will have no influence on the containment of production fluids within the basal sandstone of the Chadron Formation.

2.9.3.22.9.3.3 Groundwater Quality Data for Brule and Chadron Formations

This section does not include preoperational water quality monitoring results for the newly installed (September 2013) Arikaree Group monitoring wells or the new Brule Formation monitoring wells. The ten Arikaree monitoring wells and the 11 Brule Formation monitoring wells will be sampled monthly for a 12-month period, the results of which will serve as additional preoperational monitoring data. The first of four quarterly sampling rounds commenced in early November 2013. Submittal of the first quarter data is expected to occur in early 2014.

Three bi-weekly sampling events Four quarterly sampling events were conducted, beginning the fourth quarter of 2013 through the third quarter of 2014, at eleventen Brule Formation monitoring wells (BOW-2010-1, BOW-2010-2, BOW-2010-3, BOW-2010-4A, BOW-2010-5, BOW-2010-6, BOW-2010-7, and BOW-2010-8, BOW-9, BOW-10, and BOW-11. for March 9, March 24, and April 6, 2011. The analytical results are shown in **Tables 2.9-4** and **2.9-8**, and **Table 2.9-9**. Well 720 (Walters-1) and Well 721 (Walters-2; used for drilling makeup water) are screened across the Arikaree Group and Brule Formation. Therefore, these wells, which were previously used 2011 as monitoring wells for the Brule Formation, have been removed from **Tables 2..9-8** and **2.9-9**, and the summary values in **Table 2.9-4** have been updated to reflect deletion of these wells data. These wells will not be part of future monitoring specifically for the Brule Formation. As stated above, the results of the sampling of newly installed Arikaree monitoring wells and the 11 Brule monitoring wells will be reported in the future.