APPENDIX JD-D5:

GEOLOGY

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JD-D5.0 GEOLOGY

JD-D5.1 HISTORY

There are two lines of thought as to the origin of uranium in the Powder River Basin and Pumpkin Buttes area. The first theory places the source of uranium from the weathering of the mountain cores which have also been cited as the source for the arkosic host sandstones. The basement rocks of the Granite Mountains for example, have been determined to have high concentrations of uranium (20 to 30 parts per million). It has also been estimated that the granites have lost 70% of their original uranium content. Emplacement of the uranium under this theory would have taken place beginning 40 to 45 million years ago, shortly after the host sands were deposited in the basins. The second theory places the source of uranium as overlaying Oligocene and Miocene volcanic tuffs which as they weathered down, the uranium leached out into the groundwater system. The rhyolite volcanic tuffs were the result of volcanic activity to the west. Emplacement of the uranium has been cited as 20 to 32 million years ago. Since both theories are plausible, some geologists subscribe to a duel theory where each possible source contributed some percentage to the overall uranium occurrence.

Regardless of which source or if preferred, a duel source, the uranium came from, both would require a climate with active chemical weathering to breakdown the rock matrix and put the uranium into groundwater solution. One suggested environment for this to occur is the modern day savanna climate. Savanna climates are characterized by very wet, humid annual periods followed by hot and dry periods. This type of climate produces rapid chemical weathering and high oxidation potentials, which would have been needed to solubilize the uranium and keep it in solution until the groundwater system encountered a reducing, oxygen deficient environment such as the carbon trash rich sands in the Powder River Basin. When the uranium charged groundwater flowed into the reduced sandstone environment, the oxidized uranium precipitated out of solution along the interface between the two chemical environments. The uranium was deposited in 'C' shaped rolls, which are 5 to 30 ft thick and in plan view may be a few feet to 500 ft wide and tens of miles in length. Along the length of the trace of the chemical roll, ore grade uranium may be found; however, ore is not likely along ever mile of the front. During the time that uranium was emplaced, as is true today, the groundwater in the Powder River Basin generally flowed to the north and northwest. As the original uranium charged groundwater flowed in the host sands, the chemical reductant was consumed and the roll fronts migrated down the hydrologic gradient leaving in their wake, a characteristic yellow to red to brown stain on the sandstone grains (see Figure JD-D5-a in map pocket). As many as 11 separate roll front systems have been identified in different horizons of the Wasatch Formation in the Powder River Basin area. A diagram of stacked roll fronts is depicted in Figure JD-D5-b (map pocket).

JD-D5.2 REGIONAL GEOLOGY

The Jane Dough Unit is located in the Powder River Basin (PRB) which is a large structural and topographic depression parallel to the Rocky Mountain trend. The basin is bounded on the south by the Hartville Uplift and the Laramie Range, on the east by the Black Hills, and the Big Horn Mountains and the Casper Arch on the west. The Miles City Arch in southeastern Montana forms the northern boundary of the basin.

The PRB is an asymmetrical syncline with its axis closely paralleling the western basin margin. During sedimentary deposition, the structural axis (the line of greatest material accumulation) shifted westward resulting in the basin's asymmetrical shape. On the eastern flank of the PRB, sedimentary rock strata dip gently to the west at approximately 0.5 to 3.0 degrees. On the western flank, the strata dip more steeply, 0.5 to 15 degrees to the east with the dip increasing as distance increases westward from the axis. The Jane Dough Unit location in the PRB is shown in Figure JD-D5-1 (see map pocket).

The PRB hosts a sedimentary rock sequence that has a maximum thickness of about 15,000 ft along the synclinal axis. The sediments range in age from Recent (Holocene) to early Paleozoic (Cambrian - 500 million to 600 million years ago) and overlie a basement complex of Precambrian-age (more than a billion years old) igneous and metamorphic rocks. Geologically, the PRB is a closed depression in what was, for a long geologic time period, a large basin extending from the Arctic to the Gulf of Mexico. During Paleozoic and Mesozoic time, the configuration of this expansive basin changed as the result of uplift on its margins.

By late Tertiary - Paleocene time, marked uplift of inland masses surrounding the Powder River Basin resulted in accelerated subsidence in the southern portion of the basin with thick sequences of arkosic (containing feldspar) sediments being deposited. Arkosic sediments were derived from the granitic cores of the Laramie and Granite Mountains exposed to weathering and erosion by the Laramide uplift. Near the end of Eocene time, northward tilting and deep weathering with minor erosion took place in the basin. Subsidence resumed in the late Oligocene and continued through the Miocene and into the Pliocene. A great thickness of tuffaceous sediments were deposited in the basin during at least a part of this period of subsidence. By the late Pliocene, regional uplift was taking place, leading to a general rise in elevation of several thousand feet. The massive erosional pattern that characterizes much of the PRB began with the Pliocene uplift and continues to the present. Of particular interest in the project area are the Tertiary-age formations:

<u>FormationAge (Million Years)</u>
White River (Oligocene)25-40
Wasatch (Eocene)40-60
Fort Union (Paleocene)60-70

The White River Formation is the youngest Tertiary unit that still exists in the PRB. Locally, it's only known remnants are found on top of the Pumpkin Buttes. Elsewhere the unit consists of thick sequences of buff colored tuffaceous sediments interspersed with lenses of fine sand and siltstone. A basal conglomerate forms the resistant cap rock on top of the buttes. This formation is not known to contain significant uranium resources in this area.

The Wasatch Formation is the next unit down and consists of interbedded mudstones, carbonaceous shales, silty sandstones, and relatively clean sandstones. In the vicinity of the Pumpkin Buttes, the Wasatch Formation is known to be 1,575 ft thick (Sharp and Gibbons, 1964). The interbedded mudstones, siltstones, and relatively clean sandstones in the Wasatch vary in degree of lithification from uncemented to moderately well-cemented sandstones, and from weakly compacted and cemented mudstones to fissile shales. The Wasatch contains significant uranium resources and hosts the ore bodies for which this permit application is subject to.

The next unit is the Fort Union Formation. In the PRB this unit is lithologically similar to the Wasatch Formation. The Fort Union includes interbedded silty claystones, sandy siltstones, relatively clean sandstones, claystones, and coal. The degree of lithification is quite variable, ranging from virtually uncemented sands to moderately well-cemented siltstones and sandstones. The total thickness of the Fort Union in this area is approximately 3,000 ft. The Fort Union contains significant uranium mineralization at various locations in the basin. The Fort Union is also the target formation for Coal Bed Methane (CBM) extraction activities. CBM target depths in the Jane Dough Unit are about 1,000 and 1,200 ft. Since CBM wells have their casings cemented to the surface, no or little interference, water loss, or water invasion is anticipated other than for localized areas. Addendum JD-D6H further discusses CBM.

Maps of the surface and sub-surface geology of the Powder River Basin are depicted in Exhibits JD-D5a and JD-D5b (see map pockets).

JD-D5.3 SITE GEOLOGY

<u>Depositional Environment: Jane Dough</u>

In the Pumpkin Buttes Mining District, the Eocene Wasatch Formation hosts the geologic setting for uranium mining at the Jane Dough Unit. The Wasatch Formation in this area was deposited in a multi-channel fluvial and flood plain environment. The climate at the time of deposition was wet tropical to subtropical with medium stream and river sediment load depositing a majority of medium grained materials. The source of the sediments, as evidenced by abundant feldspar grains in the sandstones, was the near-by Laramie and Granite Mountains (see Figure JD-D5-1a).

At the Jane Dough Unit location, there are eight identified fluvial sandstone horizons or units. Beginning with the deepest unit they are the 1, A, B, C, F, G and H Sand units which are stratigraphically the same as at Nichols Ranch ISR (see Figure JD-D5-2). Separating the sand units are horizons composed of siltstones, mudstones, carbonaceous shales and poorly developed thin coals. These fine-grained materials were deposited in flood plain, shallow lake (lacustrine) and swamp environments. Ultimately, deposition of the Wasatch Formation was a function of stream bed load entering the basin and subsidence from within the basin. However, in the central part of the Powder River Basin, long periods of balanced stability occurred. During these periods the stream gradients were relatively low and allowed for development of broad (0.5 to 6.0 mi wide) meander belt systems, associated overbank deposits, and finer grained materials in flood plains, swamps and shallow bodies of water. Evidence for depositional stability exists as a number of coal bed markers with little or no channel scouring are in contact with the major sand horizons (Davis, 1970). The A Sand at Jane Dough is in close proximity to basal lignite and carbonaceous shales.

In a fluvial meandering stream process, the flow channel is sinuous in plan view with the highest flow energy concentrated on the outside edge of the channel as it turns through a meander. This results in cutting into the outside channel wall and caving material into the channel especially during flooding. In cross section view, the outside edge of a meander is the steepest and the inside of the meander is sloped more gently. The inside edge of a meander is where deposition takes place. Finer materials are deposited in the shallower (upper) slow flow region of the inside slope and coarser materials are deposited in the lower region. The major fraction of sand in the Wasatch Formation in the Pumpkin Buttes area is medium-grained with lesser fractions of coarse and fine grains. This is accompanied with mostly medium scale festoon cross bedding and current lamented cross bedding. These features can only be seen in cores. In a typical point bar sedimentation process, grain size and sediment structure fine upwards within a single point bar accumulation (see Figure JD-D5-2a).

The meandering stream environment is a process of cut and fill. Each time a cut occurs, the inside slope fills with sand and sediment. A single increment of this process results in a structure called a point bar and an accumulation of point bars is sometimes referred to as a meander belt. As the meander process progresses, meander loops eventually migrate down gradient in the direction of flow and can laterally spread out in almost any direction. The size of the complete meander belt system is a function of the size of the valley or basin and stream flow rate, load and gradient. If the subsidence rate and stream load are in the proper proportion, successive layers of meander belts, or meander belt systems, may form as the stream channel wanders back and forth during subsidence.

Meander belts in the Wasatch formation are generally 5 to 30 ft thick. The A Sand at Jane Dough is made up of three to four stacked meander belts. Individual meander belt layers will rarely terminate at the same location twice. Meanders have been noted to frequently terminate in the interior of a belt system but are more likely to terminate somewhere closer to the edge of the meander stream valley. The net effect for fluvial sands is to generally thin away from the main axis of the meander belt system. The A Sand meander belt system at Jane Dough is four miles wide as at Nichols Ranch.

On an electric log resistivity curve, the grading is apparent where the curve sharply deflects from low to higher resistance and then gradually returns to lower resistance in an upward direction. Other meander belt system sand features such as overbank and crevasse deposits are present as fingers of sand that taper out from a meander termination. These are thin sands without a lot of grain size sorting. Inter –meander channel sands occur between meanders that are migrating in different directions. These sands have more uniform grain size and show on the electric log as a semi-flat curve with only small variations. Tributary and meander cut-off channel sand features form where pre-existing sediments are scoured by a river or stream and subsequently fill with medium and coarse sediments. These channels may cut randomly into meander belts, flood plain or swamp sediments (see Figure JD-D5-2b). On the electric resistivity log, channel fills have a massive semi-rounded signature.

Jane Dough Uranium Deposition

The A Sand at Jane Dough is the same stratigraphic unit as the A Sand at Nichols Ranch. The mineralization on the east and west sides of Jane Dough are a continuation of the same chemical cell which is to be mined at Nichols Ranch.

The Jane Dough Unit and Nichols Ranch Unit ISR Project are located in the Eocene Wasatch Formation about eight miles west of the South Pumpkin Butte and straddles the Johnson and Campbell County lines. The mineralized sand horizons are in the lower part of the Wasatch, at an approximate average depth of 550 ft. The host sands are primarily arkosic in composition, friable, fine- to coarse-grained and contain trace amounts of carbonaceous material and organic debris.

The ore body at the Jane Dough Unit is a typical Powder River Basin type roll front deposit. Uranium ore, where present, is found at the interface of a naturally occurring chemical boundary between reduced sandstone facies and oxidized sandstone facies. The ore body at the Jane Dough Unit forms roughly two lateral sides, an east side and west side, and are continuations of the Nichols Ranch uranium deposit. The interior area formed by the sides and nose is the chemically oxidized sandstone facies and the exterior of the area is the reduced sandstone facies. The east side of the mineralization appears to be curvilinear in form while the west side is irregular, having two sub-noses (penetrations) as shown in Figure JD-D5-3.

The uranium ore bearing sandstone unit on the east side of the Jane Dough Unit is composed of at least two vertically stacked subsidiary roll fronts. The roll fronts have been designated the middle and lower fronts. Stacked roll fronts develop due to small differences in sandstone permeability or from the vertical contact between successive meander loop sand accumulations. The lateral surface distance between stacked rolls ranges from 0 to over 200 ft and results in some overlapping patterns. The presence or absence of one or more of the sand channels creates the thin and thick areas on the A Sand Isopach Map (Exhibit JD-D5-18). The mineralization on the west side appears to be principally one roll front which occasionally splits into three sub-rolls, having only minor lateral separation between the sub-rolls.

The Jane Dough Unit ore body has uranium mineralization composed of amorphous uranium oxide, sooty pitchblende, and coffinite. The uranium is deposited in void spaces between detrital sand grains and within minor authigenic clays. The host sandstone is composed of quartz, feldspar, accessory biotite and muscovite mica, and locally occurring carbon fragments. Grain size ranges from very fine- to very coarse sand but is medium-grained over all. The sandstones are weakly to moderately cemented and friable. Pyrite and calcite are associated with the sands in the reduced facies. Hematite or limonite stain from pyrite, are common oxidation products in the oxidized facies. Montmorillonite and kaolinite clays from oxidized feldspars are also present in the oxidized facies.

There are five notable Wasatch Formation sand units in the Jane Dough Unit mining area. The sand members have been identified as G, F, B, A, and the 1 (one) Sand units. The G Sand unit is the shallowest and the 1 Sand unit is the deepest. The principle uranium ore bearing sand unit is the A Sand. The B Sand has been designated the overlaying aquifer in the southwest portion of the Jane Dough Unit and the 1 Sand the underlying aquifer. In the east and northwest portion of the Jane Dough Unit the B Sand rests directly on the A Sand. In these areas the C, F, or G Sands may be considered the overlying aquifer. The B Sand is wide spread over the nearly all of the unit area the 1 Sand is confined to deep cut channels cut into the 1A Mudstone. Both of the A and B Sand units thin to zero in the southwest.

The Jane Dough Unit A Sand ore body is bounded above and below by aquitards. In the southwest portion of the Unit area the AB Mudstone is the upper aquitard and the 1A Mudstone is the lower aquitard. The B Sand rests directly on the A Sand in the northwest and east portions of the Unit area. In these areas the B Sand will be combined with the A Sand and the next mudstone and sand above the top of the B Sand will be considered the upper aquitard and upper aquifer, respectively. The 1A Mudstone is the lower aquitard for the entire Unit area. The upper and lower aquitards are composed of shales or mudstones, silty shales and shaley lignitic horizons. Measured permeability of the mudstones and shales has been found to be less than 0.1 millidarcies whereas the permeability of the ore sands average between 250 and 2000 millidarcies

Site geology and stratigraphy are summarized in cross section Exhibits JD-D5-1 through JD-D5-15 (see map pockets) for the Jane Dough Unit. These cross sections run north/south and east/west through the permit boundaries and ore bodies. The cross sections provide for correlation of the sand units, aquitards, and the nomenclatures utilized for the project areas. Figure JD-D5-2 details a typical stratigraphic column for the Jane Dough Unit.

Description of the Jane Dough Unit aquifers and aquitards are as follows:

Beginning with the lower monitor aquifer sand at the Jane Dough Unit, this unit has been designated the 1 (one) Sand. This sand is variable ranging from 0 to 75 ft in thickness and occurs at depths of 430 to 630 ft below the ground surface. The sand is very fine to coarse-grained and is gray in color in the Jane Dough Unit area. The 1 Sand is confined to incised valleys that cut into the 1A Mudstone. Two significant 1 Sand trends are mapped in the Jane Dough Unit area as shown on Exhibit JD-D5-16. This sand is defined by being over 10 ft thick and showing some continuity between test holes. The eastern channel runs to the north into the Nichols Ranch Unit (Nichols Ranch PA #1, Figure 2-12). The data from Jane Dough drilling suggests that it is on the order of one quarter to one half of a mile wide. The complete 1 Sand section can be seen in test hole U07D-01 (Exhibits JD-D5-7 and JD-D5-2) where the 1 Sand is 66 ft thick. No other holes were drilled completely through this interval but a few holes appear to have penetrated the top on this side of the property. On the west side the 1 Sand is observed in the test hole A36-31-016 log (Section CC; Exhibit JD-D5-3) where it is approximately 75 ft thick. This sand channel appears to also trend north-south on the west side of the mine unit. It is present in holes to the north but is not present to the east as seen in Exhibits JD-D5-12 and JD-D5-13.

Exhibits JD-D5-1 through JD-D5-15 are composed of electric logs that have penetrated deepest horizons in the local area. It is clear that the 1 Sand as described is not present in the central portion of the Jane Dough Unit even though a number of holes have been drilled well below the A Sand. There are sand stringers which are generally less than ten ft thick contained within the 1A Mudstone. These sands are difficult to see in the samples and are only observed on electric logs. On Exhibit JD-D5-16 are number marked with + signs which indicate the combined measured thickness of the sand stringers as measured on the electric log. They appear to be generally discontinuous lenses with little to no recharge. Monitor Test well URZ J1-6 (Exhibit JD-D5-5) pumped 0.5 gpm for 1000 minutes with 75 ft of drawdown. This indicates that this 1 Sand stringer might produce 0.5 gpm at this location. Monitor Test well URZ-J1-12 (Exhibit JD-D5-12) sustained a flow rate of 1.0 gpm for a few days. Monitor Test well

URZ-J1-23-1 pumped 1.5 gpm for a short time. The sand intervals that were tested as aquifers are greater than 60 ft below the base of the A Sand.

The next unit up section is the aquitard, 1A Mudstone. It consists of dark and medium gray mudstones and carbonaceous shale with occasional thin lenses of poorly developed coal. The 1A Mudstone Isopach (Exhibit JD-D5-17) shows that this unit ranges in thickness from 29 to more than 120 ft thick. The top of the 1A Mudstone is bounded by the A Sand base and by the top of the 1 Sand, where the 1 Sand is present. The holes labeled with + signs indicate the thickness between the base of the A Sand and total depth of the hole. The red numbers with + indicate this thickness of 1A Mudstone drilled is 50 ft or greater without encountering any significant 1 Sand. Where the 1 Sand channels area not present the next significant lower marker is the Badger Coal which is located approximately 120 ft below the base of the A Sand. Several holes have been drill across the mine area to the Badger Coal or reached total depths just above it. Cross sections AA and BB (Exhibits JD-D5-1 and JD-D5-2) show these relationships. The thin areas of 1A Mudstone reflects the presence of the 1 Sand channels. The isopach of the 1A Mudstone shows that many holes have been drilled to 50 beyond the base of the A Sand and have not encountered a 1 Sand channel.

The A Sand is the next unit up section. This is the mining zone sand at the Jane Dough Unit. Within the Jane Dough Unit boundary the unit has a thickness between 0 and 115 ft. The A Sand is thickest to the east and thins to the west (Exhibit JD-D5-18). The A Sand is fine- to coarse grained and is gray or red in color depending on location relative to the ore body as discussed above. The A Sand is occasionally separated by lenses of mudstone and siltstone which rarely exceed 15 ft in thickness. The mudstone lenses are generally 50 to 100 ft wide and may extend for a few hundred feet in a north/south direction. The lenses are not expected to present any problem to mining or restoration. The A Sand is extensive and has been correlated across the area between the Jane Dough and Nichols Ranch Units.

The next up section unit is Jane Dough Unit AB Shale aquitard (Exhibit JD-D5-19). It varies from 0 to 160 ft thick, thickening to the west and thinning to zero the east and northwest. This unit consists of gray mudstones and thin discontinuous light gray siltstones. Where the AB Shale aquitard is not present the B Sand sits directly upon the A Sand.

The next higher unit at the Jane Dough Unit is the B Sand upper monitor aquifer in the southwest portion of Unit area (Exhibit JD-D5-20). The B Sand ranges in thickness from 0 to 234 ft. The B Sand is fine- to coarse grained and red or oxidized within the permit boundary. Elsewhere in the Pumpkin Buttes area the B Sand is host to some large known ore bodies including those at Christensen Ranch and North Butte. The body of the B Sand is occasionally split by lenses of mudstone, siltstone, and carbonaceous shale. Some of these mudstone splits exceed 25 ft in thickness and may extend for thousands of feet. Most are more localized. The mudstones will be further delineated as drilling progresses.

Above the B Sand is the CB Mudstone aquitard (Exhibit JD-D5-26). This unit is defined as the mudstone between the top of the B Sand and the base of the C Sand (where the C Sand is present and exceeds ten feet in thickness) with the maximum thickness being defined as the top of the B Sand to the base of the first marker above the B sand. The CB Mudstone unit consists of gray mudstones and thin discontinuous light gray siltstones. It is 40 to 80 ft over most of the Jane Dough area.

The C Sand (Exhibit JD-D5-27) is defined as the sand bodies which are greater than 10 ft thick and located above the B Sand and below the first marker. This marker is a thin lignite to coal bed which is generally less that two feet thick. The C sands are up to 55 ft thick appear to be discontinuous over the unit area. They are composed of silt to medium grained sand and are gray in color. No evidence of oxidation or mineralization has been observed in this sand indicating no significant water flows have gone through this unit. The C Sand appears to be a poor aquifer as discussed in JD-D6.2 Hydrology.

The FB Mudstone is the interval from the top of the B Sand to the base of the F sand, where the F Sand is present. Where the F Sand is not present the top of the interval is defined as being from the top of the first marker to approximately 100 ft above the top of the first marker. In some portions of the Jane Dough Unit there is often a second marker (thin lignite bed) atapproximately that level but it is not always present. The FB Mudstone unit consists of gray mudstones and thin discontinuous light gray siltstones. The FB Mudstone (Exhibit DJ-D5-24) ranges from 0 to 70 ft thick across the Jane Dough area.

The F Sand is the next unit up section and includes any sand that is situated between the first marker and up to 100 ft above the 1st marker. At the Nichols Ranch Unit this unit is the shallow monitor zone sand and this would be true for some areas of Jane Dough where the C Sand is not present. This sand is medium and fine-grained, red or gray and is over 70 ft thick as mapped in Exhibit JD-D5-23. The F Sand is generally not present over the east portion of the Jane Dough Unit.

The GB Mudstone is defined as being the interval between the top of the B Sand and the base of the G Sand. This unit consists of gray mudstones, thin carbonaceous shales, poorly developed lignitic coal beds, and thin discontinuous light gray siltstones. Exhibit JD-D5-22 shows this unit's thickness ranges from 140 to 300 ft. Where the F Sand does not exist this would be the upper aquitard.

The uppermost relatively continuous aquifer in the Jane Dough Unit is the G Sand. Where the F Sand does not exist this would be the overlying aquifer. This sand is medium and fine-grained, red or gray and is over 60 ft thick as mapped in Exhibit JD-D5-21. This unit appears to be the present over most of the Jane Dough Area. It outcrops to the surface on the northern and southwest portion of the area where steep gullies have been incised into present land surface.

Peizometric surfaces for the 1, A, B, F, and G Sands can be seen on the cross sections, Exhibits JD-D5-1 through JD-D5-15. A detailed discussion of the remaining upper aquifers and aquitards can be found in the Nichols Ranch ISR Project, Appendix D5, Section D5.3, Site Geology.

Isopach maps depicting the G Sand, GB Mudstone, F Sand, FB Mudstone, C Sand, CB Mudstone B Sand, AB Shale, A Sand, 1A Shale, and 1 Sand for Jane Dough are found as Exhibits JD-D5-16 through D5-26 (see map pockets).

JD-D5.4 ABANDONED DRILL HOLES

Addendum JD-D6I of Appendix JD-D6.5-Hydrology discusses all known abandoned exploration drill holes located in the area of the Jane Dough Unit.

JD-D5.5 SEISMOLOGY

The area of central Wyoming where the Jane Dough Unit site is located lies in a relatively minor seismic region of the United States. Although distant earthquakes (such as the western Wyoming area) may produce shocks strong enough to be felt in the Powder River Basin, the region is ranked as a one (1) seismic risk as shown in Figure JD-D5-4 (see map pocket). Few earthquakes capable of producing damage have originated in this region.

The seismically active region closest to the site is the Intermountain Seismic Belt of the Western United States, which extends in a northerly direction between Arizona and British Columbia. It is characterized by shallow earthquake foci between 10 and 25 mi in depth, and normal faulting. Part of this seismic belt extends along the Wyoming-Idaho border, more than 350 km (approximately 200 mi) west of the project area. More detailed information can be found in the report "Basic Seismological Characterization for Campbell County and Basic Seismological Characterization for Johnson County, Wyoming" by the Wyoming State Geological Survey.

Table JD-D5-1 lists the largest recorded earthquakes (greater than 4.0 magnitude on the Richter Scale) that have occurred within 200 km (120 mi) of the Jane Dough Unit site and gives the maximum ground acceleration that could be realized at the site as a result of these disturbances from the period 1873 through 2006 (Sources–Wyoming State Geological Survey, 2002 and USGS, 2007). The earthquake of highest intensity recorded during that time interval was the Casper, Wyoming earthquake of 1897. This earthquake has been assigned a probable maximum Mercalli shaking intensity of VI -VII (5.7 on the Richter scale) based on accounts of damage incurred.

No surface faulting or fault traces in the project area has been reported, nor is any faulting evident from geophysical log interpretations. Based on historic data, the ground accelerations reported in Table JD-D5-1 (.01g to .04g) are not considered to be of a magnitude that would disturb the operations or facilities in the event that an earthquake occurred.

Table JD-D5-1

MAXIMUM EXPECTED EARTHQUAKES INTENSITIES AND GROUND ACCELERATIONS AT THE JANE DOUGH UNIT SITE

Earthquake Location and Year	Epicenter Intensity (Mercalli)	Magnitude (Richter)	Distance From Jane Dough Unit	Ground Acceleration at Jane Dough Unit
Casper (1894)	V	4.5	65	0.01g
Casper (1897)	VI-VII	5.7	64	0.04g
Kaycee (1965)	V	4.7	30	0.02g
Pine Tree Jct. (1967)	V	4.8	10	0.04g
West of Gillette (1976)	IV-V	4.3	38	0.02g
SW of Gillette (1976)	V	4.8	18	0.03g
Bar Nunn (1978)	V	4.6	56	0.01g
West of Kaycee (1983)	V	4.8	65	0.01g
West of Gillette (1984)	V	5.1	30	0.03g
West of Gillette (1984)	V	5	28	0.03g
Laramie Mtns (1984)	VI	5.5	95	0.01g
Mayoworth (1992)	V-VI	5.2	52	0.02g
W Converse Co. (1996)	IV-V	4.2	54	0.01g