7.5 EFFECTS OF ACCIDENTS

Accidents involving human safety associated with the ISR uranium mining technology typically have far less severe consequences that accidents associated with underground and open pit mining methods. In-situ mining provides a higher level of safety for employees and neighboring communities when compared to conventional mining methods or other energy related industries. Accidents that may occur would generally be considered minor when compared to other industries. Radiological accidents that might occur would typically manifest themselves slowly and are therefore easily detected and mitigated. The remote location of the Moore Ranch facility and the low level of radioactivity associated with the process combine to decrease the potential hazard of an accident to the general public.

NRC has previously evaluated the effects of accidents at conventional uranium milling facilities in NUREG–0706[9] and specifically at ISR uranium facilities in NUREG/CR-6733[10]. These analyses demonstrate that, for most credible potential accidents, consequences are minor so long as effective emergency procedures and properly trained personnel are used. The proposed Moore Ranch facilities are consistent with the operating assumptions, site features, and designs examined in the NRC analyses in NUREG/CR-6733. EMC will develop emergency management procedures to implement the recommendations contained in the NRC analyses. Training programs will be developed to ensure that EMC personnel are adequately trained to respond to all potential emergencies. These training programs were discussed in detail in Section 5.

NUREG-0706 considered the environmental effects of accidents at single and multiple uranium milling facilities. Analyses were performed on incidents involving radioactivity and classified these incidents as trivial, small, and large. NUREG-0706 also considered transportation accidents. Some of the analyses in NUREG-0706 are applicable to ISR facilities, such as transportation accidents. NUREG/CR-6733 specifically addressed risks at ISR facilities and identified the "risk insights" that are discussed in the following sections.

7.5.1 Chemical Risk

NUREG/CR-6733 noted that the scope of the NRC mission includes hazardous chemicals to the extent that mishaps with these chemicals could affect releases of radioactive materials. Industrial safety aspects associated with the use of hazardous chemicals at Moore Ranch is regulated by the Wyoming Occupational Safety and Health Administration (OSHA).

7.5.1.1 Sulfuric Acid

Sulfuric acid may be used to split the uranyl carbonate complex from rich eluate into carbon dioxide gas and uranyl ions in preparation for precipitation using hydrogen peroxide. A 93 percent sulfuric acid solution will be stored outdoors and outside the processing plant in a cross-linked high-density polyethylene flat bottom tank. The tank will be founded in a concrete secondary containment system that is sized to hold 100% of the tank's volume plus a 25-year precipitation episode for 24 hours. The surface of the concrete containment area will be treated with an appropriate coating that could include but not be limited to an acid proof epoxy coating. No other chemicals will be stored in the sulfuric acid secondary containment area. A vent pipe will be fitted to the storage tank and will route vapors to a water bath or circulating water system. Here, acid vapors quickly react with the water to form a dilute sulfuric acid solution. The solution will then be treated with an appropriate base such as soda ash to neutralize the dilute acid solution. Alternately, the vent pipe will be fitted with a demister system to mitigate any acid vapors from releasing to the atmosphere.

In the presence of 93 percent sulfuric acid, the interior of carbon steel pipe will initially corrode to form a thin film of iron sulfate on the surface of the metal. Once formed, the iron sulfate film prevents further corrosion of the underlying material. For this reason, Schedule 80 black steel pipe with forged welding fittings will be used to transport the acid from the storage tank to the elution tanks or other points of application. Proper valving will be installed at the tank exit, both sides of the redundant pumps, and a re-routing piping arrangement downstream from the pumps will be installed to purge the exit lines to the pregnant eluant tanks and return any residual acid in the lines to the outdoor storage tank. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard operating procedures (SOPs) will be developed and operators will be trained on using these systems, both automated and manual.

NUREG\CR-6733 does not specify the size of the sulfuric acid storage tank but considers the use of a smaller 450 gallon day tank located within the plant building. EMC does not plan to use a day tank in order to mitigate this potential source for leaks and spills of sulfuric acid. The concentration of sulfuric acid fumes that are immediately dangerous to life and health (IDLH) is 15 mg/m^3. In the risk analysis from NUREG/CR-6733, a spill of 93 percent sulfuric acid was not deemed a significant inhalation hazard to workers as long as normal air dilution is available from the facility ventilation system. If the ventilation system for the Moore Ranch CPP were not operational at the time of a sulfuric acid spill, workers would be required to exit the building. This scenario is unlikely since the ventilation system design includes redundant ventilation blowers to ensure adequate ventilation at all times for the control of chemical and radioactive fumes and gases.

NUREG/CR-6733 also noted that sulfuric acid reacts vigorously with ammonia, sodium carbonate, and water, all of which will be present at Moore Ranch.

The use of sulfuric acid is subject to Threshold Planning Quantities (TPQs) contained in 40 CFR Part 355, Emergency Response Plans for threshold quantities (TQs) in excess of 1,000 pounds. As discussed in Section 3, the Moore Ranch design includes a sulfuric acid tank with a capacity of 12,000 gallons. Based on the design capacity, EMC will be subject to the Emergency Response Plan requirements.

Accident Prevention

Prevention methods utilized to minimize potential impacts to human health and the environment from a release of sulfuric acid include the following:

- To minimize the potential for chemical reactions in the unlikely event of simultaneous tank leaks, the sulfuric acid storage tank will be located separately from other process tanks.
- Construction of all storage tanks, piping, and associated appurtenences will be in accordance with current industry standards.
- All tanks are enclosed limiting the amount of vapors that can escape to the atmosphere.
- Daily shift inspections of plant and chemical storage facilities are conducted for early detection of potential deficiencies.
- Containment will be provided for 110% of the total storage capacity constructed of chemically compatible materials.
- Typically, a Concentrated Acid Work Permit will be required for maintenance work on tanks, pipes, or equipment that contains or may contain concentrated acid or to the use of concentrated acid to prepare decontamination or cleaning solutions as required by site industrial safety procedures.
- Offloading procedures will be developed and implemented to ensure proper steps and precautions are followed during offloading into bulk storage areas.

Mitigation/Accident Response

Upon detection of a release of sulfuric acid, steps will be taken to stop or limit the extent of the release that can be performed without endangering the health of the responders. EMC will develop emergency response procedures for an accidental release of sulfuric acid and employees will be trained on those procedures. Emergency response procedures will include instructions in the following:

- Immediate notifications
- Evacuation procedures
- Perimeter establishment
- Personal Protective Equipment requirements
- Site mitigation, neutralization, and cleanup
- Reporting

As a minimum, an acid-rated respirator, face shield, overall or apron and gloves will be required during the cleanup of any acid spill. Additionally, eye wash stations as well as deluge type emergency showers will be located in close proximity to any areas where will be used.

7.5.1.2 Hydrochloric Acid

As an alternative to sulfuric acid discussed in the previous section, hydrochloric acid may be used to split the uranyl carbonate complex from rich eluate into carbon dioxide gas and uranyl ions in preparation for precipitation using hydrogen peroxide. A 35 percent hydrochloric acid solution will be stored outdoors and outside the processing plant in a cross-linked high-density polyethylene flat bottom tank. The tank will be founded in a concrete secondary containment system that is sized to hold 100% of the tank's volume plus a 25-year precipitation episode for 24 hours. The surface of the concrete containment area will be treated with an appropriate coating that could include but not be limited to an acid proof epoxy coating. No other chemicals will be stored in the hydrochloric acid secondary containment area. A vent pipe will be fitted to the storage tank and will route vapors to a water bath or circulating water system. Here, acid vapors quickly react with the water to form a dilute sulfuric acid solution. The solution will then be treated with an appropriate base such as soda ash to neutralize the dilute acid solution. Alternately, the vent pipe will be fitted with a demister system to mitigate any acid vapors from releasing to the atmosphere.

CPVC (chlorinated PVC) schedule 80 piping with Latharge Viton or EDPM gaskets will be used to transport the hydrochloric acid from the storage tank to the elution tanks or other points of application. Proper valving will be installed at the tank exit, both sides of the redundant pumps, and a re-routing piping arrangement down stream from the pumps will be installed to purge the exit lines to the pregnant eluant tanks and return any residual acid in the lines to the outdoor storage tank. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard operating procedures (SOPs) will be developed and operators will be trained on using these systems, both automated and manual.

Hazard Analysis Calculations:

NUREG\CR-6733 does not specify the size of the hydrochloric acid storage tank. EMC performed an analysis of the potential air concentrations of hydrochloric acid fumes using a scenario similar to that considered in NUREG\CR-6733 and applying the following specific characteristics of the Moore Ranch design:

- Flow rate of 35 percent HC1 to the process = 11.355 L/min (3 gpm)
- Volume of the process building = (200 x 140 x 24) ft^3 = 672,000 ft^3 = (672,000 x 0.02831) = 19,024 m^3.
- Process building HVAC system is designed for 3 air changes per hour.

Similar to NUREG\CR-6733, a leak in the piping system of 150 ml/min (0.04 gpm) which goes undetected for 30 min was assumed.

Volume of leak = (0.04 x 30) L = 4.5 L (1.19 gal.)

Mass of leak = 4.5 L x 1.1493 kg/L = 5.2 kg (5.2 x 10^6 mg)

Mass of HC1 in leaked solution = (5.2 x 10^6) x 0.35 = (1.82 x 10^6) mg in 30 min

In 30 minutes the building HVAC system will have performed 1.5 air change volumes of the process building = 28,536 m^3

Volume of air in which the leaked HCl can volatilize = (1 + 1.5) x 19,024 m^3 = 47,560 m^3

Concentration of HC1 vapor in process building = (1.82 x 10^6) mg/47,560 m^3 = 38.3 mg/m^3

IDLH for HCl vapor = 50 ppm = (50 x 1.52) mg/m3 = 76 mg/m3

This analysis illustrates that an HCl piping system leak at the Moore Ranch facility would have the potential to result in localized vapor concentrations of about half the IDLH value within approximately 30 min.

The use of hydrochloric acid is subject to Reporting Quantities (RQs) contained in 40 CFR Part 302.4 for quantities in excess of 5,000 pounds. Based on the design capacity, EMC will be subject to the Reporting Quantities.

Accident Prevention

Prevention methods utilized to minimize potential impacts to human health and the environment from a release of sulfuric acid include the following:

- To minimize the potential for chemical reactions in the unlikely event of simultaneous tank leaks, the hydrochloric acid storage tank will be located separately from other process tanks.

- Construction of all storage tanks, piping, and associated appurtenances will be in accordance with current industry standards.

- The acid tank will be enclosed and will employ a vapor control system on the tank vent, limiting the amount of vapors that can escape to the atmosphere.

- Daily shift inspections of plant and chemical storage facilities are conducted for early detection of potential deficiencies.

- Containment will be provided for 100 % of the total storage capacity plus a 25-year precipitation episode for 24 hours. Containment will be constructed of chemically compatible materials.

- Typically, a Concentrated Acid Work Permit will be required for maintenance work on tanks, pipes, or equipment that contains or may contain concentrated acid or to the use of concentrated acid to prepare decontamination or cleaning solutions as required by site industrial safety procedures.

- Offloading procedures will be developed and implemented to ensure proper steps and precautions are followed during offloading into bulk storage areas.

Mitigation/Accident Response

Upon detection of a release of hydrochloric acid, steps will be taken to stop or limit the extent of the release that can be performed without endangering the health of the responders. EMC will develop emergency response procedures for an accidental release of sulfuric acid and employees will be trained on those procedures. Emergency response procedures will include instructions in the following:

- Immediate notifications

- Evacuation procedures
- Perimeter establishment
- Personal Protective Equipment requirements
- Site mitigation, neutralization, and cleanup
- Reporting

As a minimum, an acid-rated respirator, face shield, overall or apron and gloves will be required during the cleanup of any acid spill. Additionally, eye wash stations as well as deluge type emergency showers will be located in close proximity to any areas where will be used.

7.5.1.3 Sodium Hydroxide

Sodium hydroxide is used for pH adjustment during the precipitation process. The sodium hydroxide will be stored in a tank located in the processing plant for use in the precipitation circuit. The 50% sodium hydroxide solution will be stored in an 11,844 gallon fiberglass tank with a vent pipe routed through the roof to the atmosphere outside and above the CPP. A concrete containment berm will be constructed within the plant to contain spills to the immediate area. The berm will be constructed to a height of 6 inches. The sodium hydroxide will be transported using conventional PVC piping from the fiberglass storage vessel into the CPP precipitation tanks. Sodium hydroxide reacts vigorously with sulfuric and hydrochloric acid, one of which will also be present in the precipitation circuit.

Hazard Analysis Calculation:

NUREG\CR-6733 only considered the use of sodium hydroxide for pH control during radium removal from the barren lixiviant bleed stream using a conventional barium/radium sulfate co-precipitation process. 55-gallon drum were assumed for storage. NUREG\CR-6733 did not consider the use of bulk sodium hydroxide for pH control during precipitation, which is curious since this application is common at operating facilities. EMC has performed a hazard analysis similar to the spill scenario contained in NUREG\CR-6733 using specific design data for the Moore Ranch CPP. NUREG\CR-6733 noted that sodium hydroxide is not volatile and that a spill of 50-percent sodium hydroxide solution would not pose a significant inhalation hazard to workers.

The use of sodium hydroxide is subject to the following regulatory program:

- Reportable Quantities (RQs) for spills from the Comprehensive Environmental, Response, Compensation and Liability Act (CERCLA) in 40 CFR § 302.4 for spills in excess of 1,000 pounds.

As discussed, the Moore Ranch design includes a sodium hydroxide tank with a capacity of 11,844 gallons. Based on this design capacity, EMC will be subject to all of the aforementioned regulatory programs.

7.5.1.4 Hydrogen Peroxide

Hydrogen peroxide will be used in the precipitation phase at Moore Ranch. A 50-percent solution of hydrogen peroxide will be added to the acidified uranium-rich eluant to form an insoluble uranyl peroxide compound. Hydrogen peroxide is a strong oxidizer and is a reactive, easily decomposable compound. Its hazardous decomposition products include oxygen and hydrogen gas, heat, and steam. Decomposition can be caused by mechanical shock, incompatible materials including alkalies, light, ignition sources, excess heat, combustible materials, strong oxidants, rust, dust, and a pH above 4.0. When sealed in strong containers, the decomposition of hydrogen peroxide can cause excessive pressure to build up which may then cause the container to burst explosively.

A 50% solution of hydrogen peroxide will be stored in a horizontal aluminum pressure vessel tank with a pressure actuated relief valve installed in the vent pipe for safety. The storage tank will be located outdoors and outside the main plant. Upon relief, the vapors dissociate to water and oxygen, therefore no vapor scrubbing system is required. A containment berm will be constructed meeting 40 CFR §264.193 for spill mitigation. Hydrogen peroxide will be transported using PVC piping from the exterior storage vessel into the main plant to the precipitation tanks. Proper valves will be installed at the tank exit and both sides of the redundant pumps. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard operating procedures (SOP's) will be developed and operators will be trained on using these systems, both automated and manual. Eye wash stations as well as deluge type emergency showers will be located in close proximity to the areas where hydrogen peroxide is used.

<u>Hazard Analysis Calculations:</u>

NUREG\CR-6733 does not specify the size of the hydrogen peroxide storage tank, simply stating that it is typically a large tank located outdoors. EMC performed an analysis of the potential air concentrations of hydrogen peroxide using a scenario similar to that considered in NUREG\CR-6733 and applying the following specific characteristics of the Moore Ranch design:

- Flowrate of 50-percent H_2O_2 solution = 1.14 Lpm (0.3 gpm)
- Volume of the process building = (200 x 140 x 24) ft^3 = 672,000 ft^3 = (672,000 x 0.02831) = 19,024 m^3.
- Process building HVAC system is designed for 3 air changes per hour.

Similar to NUREG\CR-6733, a leak in the piping system of 0.38 LPM (0.1 gpm) which goes undetected for 10 min was assumed.

Volume of leak = (0.1 gpm x 3.7854 L/gal. x 10) = 3.7854 L.

Mass of leak = (3.7854 L x 1.1 kg/L) kg = (4.063 x 10^6) mg.

Mass of H_2O_2 in leaked solution = (4.063 x 10^6)/2 = (2.032 x 10^6) mg.

In 10 min., the building HVAC system will have performed (3 x 10/60) air changes = 0.5 air changes.

Volume of the process building = 19,024 m^3.

Volume of air in which the leaked H_2O_2 can volatilize = (1 + 0.5) x 19,024 m^3 = 28,536 m^3.

Concentration of H_2O_2 vapor in process building = (2.032 x 10^6 mg)/28,536 m^3 = 71.2 mg/m^3 or 99.7 ppm.

IDLH for H_2O_2 vapor = 75 ppm = (75 x 1.4) mg/m3 = 105 mg/m3.

As noted in NUREG/CR-6733, a hydrogen peroxide piping system leak in a process building has the potential to result in localized vapor concentrations in excess of the IDLH value of 75 ppm within several minutes. A leak in a confined space has the potential to generate lethal concentrations of vapor at an even faster rate. EMC will incorporate recommendations concerning materials of construction for tanks and piping systems and the use of local ventilation with explosion-proof fans to control vapors in the event of a leak of hydrogen peroxide. The building HVAC system is designed for 3 air changes per hour with the capacity to expand to 6 air exchanges per hour. In addition, local exhaust fans will be installed along the outer plant wall to sweep vapors and gases near the floor level.

The use of hydrogen peroxide at concentrations greater than 52 percent is subject to the following regulatory programs:

- Process Safety Management of Highly Hazardous Chemicals standard contained in 29 CFR §1910.119 for TQs in excess of 7,500 pounds; and
- Threshold Planning Quantities (TPQs) contained in 40 CFR Part 355, Emergency Response Plans for threshold quantities (TQs) in excess of 1,000 pounds.

As discussed in Section 3, the Moore Ranch design includes the use of hydrogen peroxide at a concentration of 50 percent contained in a hydrogen peroxide tank with a capacity of 10,000 gallons. With the design hydrogen peroxide concentration and capacity, EMC will not be subject to the aforementioned regulatory programs.

Accident Prevention

Prevention methods utilized to minimize potential impacts to human health and the environment from a release of hydrogen peroxide include the following:

- To minimize the potential for chemical reactions in the unlikely event of simultaneous tank leaks, the hydrogen peroxide storage tanks will be located separately from other process tanks.

- Construction of all storage tanks, piping, and associated appurtenances will be in accordance with current industry standards.

- All tanks are enclosed limiting the amount of vapors that can escape to the atmosphere.

- Daily shift inspections of plant and chemical storage facilities are conducted for early detection of potential deficiencies.

- Containment will be provided for 110% of the total storage capacity constructed of chemically compatible materials.

- Offloading procedures will be developed and implemented to ensure proper steps and precautions are followed during offloading into bulk storage areas.

Mitigation/Accident Response

Upon detection of a release of hydrogen peroxide, steps will be taken to stop or limit the extent of the release that can be performed without endangering the health of the responders. EMC will develop emergency response procedures for an accidental release of sulfuric acid and employees will be trained on those procedures. Emergency response procedures will include instructions in the following:

- Immediate notifications
- Evacuation procedures
- Perimeter establishment
- Personal Protective Equipment requirements
- Site mitigation, neutralization, and cleanup
- Reporting

7.5.1.5 Oxygen

Oxygen presents a substantial fire and explosion hazard. The design and installation of the oxygen storage facility is typically performed by the oxygen supplier and meets applicable industry standards. The oxygen will be delivered to Moore Ranch by truck and stored on site under pressure in a cryogenic tank in liquid form. The oxygen will be allowed to evaporate and will be added to the barren lixiviant upstream of the injection manifold.

The oxygen storage system will consist of 30-ton bulk liquid oxygen pressure vessel(s) at each wellfield. The tanks will be supplied and maintained by the liquid oxygen supplier. All oxygen deliveries and tank fillings are performed by the tank supplier. Gaseous oxygen, formed by the air heated evaporators, is then routed via low carbon steel piping that has been properly degreased from the bulk storage tank to individual header houses. After entering the header house the oxygen supply line is routed into the barren lixiviant using a single injection port and mixed with the lixiviant along a common manifold. Oxygen saturated lixiviant is metered from the common manifold and routed to the individual injection wells. Oxygen saturation pressure is a function of the water head or pressure above the uranium bearing sands. Totally enclosed fan cooled (TEFC) motors, solenoids, valves, pressure gauges, exhaust ventilation systems and alarm safety devices are included in the design for accident mitigation.

Accident Prevention

Prevention methods utilized to minimize potential impacts to human health and safety from a release of oxygen include the following:

- The design and installation of underground and above-ground gaseous oxygen piping at Moore Ranch including material specifications, velocity restrictions, location and specifications for valves, and design specifications for metering stations and filters will be in accordance with industry standards contained in CGA G-4.4.
- Header houses will be equipped with an exhaust ventilation system to reduce the risks of O_2 accumulation in case of a leak.
- Oxygen monitoring will be conducted prior to entry into confined spaces where oxygen buildup could occur.
- Normally closed solenoids will reduce the risk of O_2 leaks in the lixiviant injection piping.

Combustibles such as oil and grease will burn in oxygen if ignited. EMC will ensure that all oxygen service components are cleaned to remove all oil, grease, and other combustible material before putting them into service. Acceptable cleaning methods are described in CGA G-4.1[11].

Mitigation/Accident Response

EMC will develop procedures that implement emergency response instructions for a spill or fire involving oxygen systems. Emergency response procedures will include instructions in the following:

- Immediate notifications
- Evacuation procedures
- Perimeter establishment
- Personal Protective Equipment requirements
- Reporting

7.5.1.6 Carbon Dioxide

The primary hazard associated with the use of carbon dioxide is concentration in confined spaces, presenting an asphyxiation hazard. Bulk carbon dioxide facilities are typically located outdoors and are subject to industry design standards. Floor level ventilation and carbon dioxide monitoring at low points will be performed to protect workers from undetected leaks of carbon dioxide within the central plant.

The carbon dioxide storage system will consist of one 50-ton bulk liquid carbon dioxide pressure vessel tank supplied and maintained by the carbon dioxide supplier. The tank will be located outdoors and outside the main plant. All carbon dioxide deliveries and tank fillings will be performed by the supplier. Gaseous carbon dioxide is routed via carbon steel piping from the bulk storage tank to both the production and injection main lines.

EMC will incorporate recommendations concerning materials of construction for tanks and piping systems and the use of ventilation to control vapors in the event of a leak of carbon dioxide. The building HVAC system is designed for 3 air changes per hour with the capacity to expand to 6 air exchanges per hour. In addition, local exhaust fans will be installed along the outer plant wall to sweep vapors and gases near the floor level.

7.5.1.7 Sodium Carbonate and Sodium Chloride

Sodium carbonate and sodium chloride are primarily inhalation hazards. Soda ash and carbon dioxide will be used to prepare sodium carbonate for injection in the wellfield. Sodium carbonate and sodium chloride are also used for regeneration of ion exchange resin.

A 26 percent sodium chloride saturated solution will be created from pure salt solids transferred using aluminum piping into two 15,230 gallon vertical flat bottom reinforced fiberglass tanks with a vent pipe vented through the roof to the atmosphere outside and above the main plant. Water is pumped into the storage tanks using PVC piping and the salt dissolves until solution saturation is achieved.

A 32 percent soda ash saturated solution will be created from dense soda ash solids transferred into a 16,920 gallon vertical flat bottom reinforced fiberglass tank with a vent pipe vented through the roof to the atmosphere outside and above the main plant. Hot water is pumped using copper pipe into the storage tank and the soda ash dissolves until solution saturation is achieved. Solution temperature is maintained at a minimum of 95°F to avoid solids precipitation of the soda ash solution.

All piping from both systems to the eluate system will be conventional PVC. Proper valving will be installed at the tank exits and both sides of the redundant pumps. A programmable logic control system integrated to the plant automation system will control the pump starts, flow rates, and time as it relates to volume needed. Standard operating procedures (SOPs) will be developed and operators will be trained on using these systems, both automated and manual.

Accident Prevention

Prevention methods utilized to minimize potential impacts to human health and the environment from a release of sodium carbonate and sodium chloride include the following:

- To minimize the potential for chemical reactions in the unlikely event of simultaneous tank leaks, the hydrogen peroxide storage tanks will be located separately from other process tanks with incompatible chemicals.

- Dry storage and handling systems will be designed to industry standards to control the discharge of dry material.

- All tanks are enclosed limiting the amount of dust that can escape to the atmosphere.

- Daily shift inspections of plant and chemical storage facilities are conducted for early detection of potential deficiencies.

- Bulk storage facilities will be located inside of the central plant providing full containment of released materials.

- Offloading procedures will be developed and implemented to ensure proper steps and precautions are followed during offloading into bulk storage areas.

Mitigation/Accident Response

Upon detection of a release, steps will be taken to stop or limit the extent of the release that can be performed without endangering the health of the responders. EMC will develop emergency response procedures for an accidental release of sulfuric acid and employees will be trained on those procedures. Emergency response procedures will include instructions in the following:

- Immediate notifications
- Evacuation procedures
- Perimeter establishment
- Personal Protective Equipment requirements

- Site mitigation, neutralization, and cleanup
- Reporting

7.5.1.8 Sodium Sulfide

Sodium sulfide may be used as a reductant during groundwater restoration. Sodium sulfide is corrosive and will cause severe eye and skin burns. Routes of entry into the body include inhalation, ingestion, and contact with the skin. Under low pH conditions, sodium sulfide can react with water to liberate hydrogen sulfide gas.

Accident Prevention

Prevention methods utilized to minimize potential impacts to human health and the environment from a release of sodium sulfide include the following:

- Sodium sulfide can be flammable and contact with heat, flame, or other sources of ignition will be avoided.

- Sodium sulfide will be stored separately from incompatible chemicals such as hydrogen peroxide and sulfuric acid.

- Construction of all storage tanks, piping, and associated appurtenences will be in accordance with current industry standards.

- All tanks are enclosed limiting the amount of vapors that can escape to the atmosphere.

- Daily shift inspections of plant and chemical storage facilities are conducted for early detection of potential deficiencies.

- Containment will be provided for 110% of the total storage capacity constructed of chemically compatible materials.

- Offloading procedures will be developed and implemented to ensure proper steps and precautions are followed during offloading into bulk storage areas.

Mitigation/Accident Response

Upon detection of a release of sodium sulfide, steps will be taken to stop or limit the extent of the release that can be performed without endangering the health of the responders. EMC will develop emergency response procedures for an accidental release of sulfuric acid and employees will be trained on those procedures. Emergency response procedures will include instructions in the following:

- Immediate notifications
- Evacuation procedures
- Perimeter establishment
- Personal Protective Equipment requirements
- Site mitigation, neutralization, and cleanup
- Reporting

7.5.2 Radiological Risk

7.5.2.1 Tank Failure

A spill of the materials contained in the process tanks at the Moore Ranch Project will present a minimal radiological risk. Process fluids will be contained in vessels and piping circuits within the central plant. The tanks at Moore Ranch will contain injection and production solutions, ion exchange resin, pregnant eluant, yellowcake, and liquid waste.

NUREG/CR-6733 analyzed the potential impacts of a failure of a yellowcake thickener resulting in a release of 20% of the contents outside the plant structure. This postulated accident scenario was based on an event at the Irigaray ISR facility in 1994. The event in question was caused by the failure of an inadequate concrete pad supporting the thickener. The subsequent release from the building was a result of the proximity of the thickener to the plant wall. NUREG/CR-6733 concluded that, based on conservative calculations of this unlikely event, the dose to the public would be below the limits in 10 CFR Part 20. The calculations resulted in a dose to an unprotected worker in excess of the exposure limits from 10 CFR Part 20 (i.e., 5 rem). However, this dose estimate was based on a number of unlikely, conservative assumptions. The scenario made the unrealistic assumption that no efforts would be made to clean up the spill, allowing the yellowcake to dry and become transportable. The dose was based on lung clearance class Y uranium, which produces the highest dose estimates. No allowance in the dose calculation was made for the use of protective equipment, including protection factors from the use of respiratory protection equipment.

NUREG/CR-6733 also assessed the potential dose from a catastrophic spill from an ion exchange column resulting in the release of the entire contents of the vessel and the resultant release of radon gas. Based on a number of assumptions, the predicted dose was

1.3 rem in a 30-minute period to a worker in the area. Any change to the Rn-222 concentration or exposure time has a linear affect on dose. For example, if the room size is doubled or the exposure time is halved, then the dose will be halved. NUREG/CR-6733 recommended that the use of ventilation or atmosphere-supplying respirators designed to protect against gases would be sufficient to mitigate doses, that unprotected personnel should evacuate spill areas near ion-exchange columns, and that ISR facilities maintain proper equipment, training, and procedures to respond to large lixiviant spills or ion-exchange column failure.

As discussed in Section 4.2.3.2, a concrete curb will be built around the entire central process plant building to contain spilled liquids. The curb is designed to hold 12,200 cubic feet (91,256) gallons. The largest liquid-containing vessel in the plant is the yellowcake thickener with a maximum capacity of 9,263 cubic feet (69,300 gallons). Therefore, the building curb capacity will be adequate to contain the contents of the largest tank in the plant.

NRC staff requested that EMC address the likelihood of and measures for preventing a multiple tank failure such as might occur if one failed tank fell into an adjacent tank. The next largest liquid-containing vessel in the central plant is the pregnant eluant tank with a maximum capacity of 3,079 cubic feet (23,031 gallons). Although the yellowcake thickener and the pregnant eluant tank are not adjacent to each other and would therefore not be subject to the scenario postulated by NRC staff of one tank falling into another, the "worst-case" scenario of these two liquids-containing vessels failing at the same time would cause a maximum spill volume of 12,342 cubic feet. The plant retention volume is 12,200 cubic feet within the 6 inch curbing area. Therefore, the maximum volume spilled in this unlikely scenario would slightly exceed the plant curb capacity. However, it should be noted that the cited tank capacities are based on the maximum volume and not the operating volume.

Construction of tanks and vessels will be in accordance with ASME and ASTM codes, providing sufficient liquid containment for potential releases. In addition, standard operating procedures for central processing plant operations will be used by EMC to minimize the potential of releases escaping the central processing plant primary containment systems.

There are a number of unlikely scenarios that could cause the failure of multiple tanks other than one tank falling into another tank. These primarily relate to natural disasters. For instance, an earthquake or a direct strike by a tornado could cause failures that would lead to leaks from multiple tanks. The likelihood of these events is discussed in Sections 2.6.6 and 2.5, respectively. The radiological impacts from these scenarios are discussed in Section 7.5.8 and address the primary radiological hazard, which would be the release of yellowcake. It is possible that in the unlikely event of multiple tank failures due to a natural disaster, the plant curb may not be able to contain all of the liquid released in the plant. However, the radiological risk of such an event is minimal and is bounded by the analysis in Section 7.5.8. Spilled liquids containing radioactive material released outside the plant containment would quickly absorb into the surrounding soil and would not present a radiological risk to workers or the public beyond that discussed in section 7.5.8. Any released radioactive material would be cleaned up using reclamation procedures as discussed in Section 6.2. The following sections discuss accident prevention and mitigation/accident response measures.

Accident Prevention

The plant will be designed to control and confine liquid spills from tanks should they occur. The central plant building structure and concrete curb will contain the liquid spills from the leakage or rupture of a process vessel and will direct any spilled solution to a floor sump. The floor sump system will direct any spilled solutions back into the plant process circuit or to the waste disposal system. Bermed areas, tank containments, and/or double-walled tanks will perform a similar function for any process chemical vessels located outside the central plant building.

All tanks will be constructed of fiberglass or steel with the exception of the hydrogen peroxide storage tank, which will typically be constructed of aluminum. Instantaneous failure of a tank is unlikely. Tank failure would more likely occur as a small leak in the tank. In this case, the tank would be emptied to at least a level below the leaking area and repairs or replacement made as necessary. Other prevention methods include shift inspections of plant areas including tanks.

Mitigation/Accident Response

The Moore Ranch Central Plant will be designed in accordance with standard industry building codes and will incorporate containment adequate to contain the contents of the largest tank in the facility at a minimum. As discussed in Section 4.1, area ventilation will be provided to control concentrations of airborne radioactive material in the central plant. Finally, EMC will prepare spill response procedures, provide spill response equipment and materials, require the use of protective equipment, and will train employees in proper spill response methods. Emergency response procedures will include instructions in the following:

- Immediate notifications
- Evacuation procedures
- Perimeter establishment

- Personal Protective Equipment requirements
- Site mitigation, neutralization, and cleanup
- Reporting

7.5.2.2 Plant Pipe Failure

The rupture of a pipe within the central plant will be easily detected by operating staff and can be quickly controlled. Spilled solution will be contained and managed in the same fashion as for a tank failure.

7.5.2.3 Yellowcake Dryer Accident

NUREG/CR-6733 analyzed the potential effects of accidents involving yellowcake dryers by examining the scenarios analyzed in NUREG-0706. The impact analysis for the four scenarios in NUREG-0706 (i.e., fire and explosion in the yellowcake drying area, discharge valve at bottom of dryer fails open, failure of offgas treatment system on one dryer, and tornado strikes to the dryer room) were based on two yellowcake dryers, each having a capacity of 4,300 1b of yellowcake, and two yellowcake dryer feed hoppers, each with a 155 ft^3 volume. NUREG-0706 also reports an upper-limit failure rate of 5 x 10^{-3} per plant year. NUREG/CR-6733 notes that this frequency appears to be for a gas-fired multiple hearth dryer based on failure rates for piping used in the transmission of natural gas. NUREG/CR-6733 concludes that the failure rate for the rotary vacuum dryer is likely to be less since it is not a gas-fired unit and uses hot oil as the heating medium for drying the yellowcake. However, the analysis did not quantify the expected failure rate for a hot oil-heated vacuum dryer. A gas explosion for the Moore Ranch yellowcake dryer is not a credible scenario since the dryer is heated with hot oil, eliminating the potential for an gas explosion at the dryer.

Of the four scenarios, NUREG/CR-6733 noted that the fire and explosion scenario bounded the analysis for discharge valve failure and tornado strike. The remaining scenario, failure of the offgas treatment system, is specific to gas-fired multiple hearth dryers. For the purposes of the Moore Ranch design, use of the fire and explosion scenario will provide a bounding analysis for an accident involving a large quantity of dried radioactive material.

The Moore Ranch design includes one rotary vacuum dryer with a maximum capacity of 7,353 pounds of yellowcake. This capacity is based on an optimal dryer loading of 60 percent of the dryer capacity and 35 percent solids and 65 percent liquid by weight slurry from the filter press. The yellowcake hopper from the filter press to the dryer has a maximum capacity of 366 cubic feet of wet yellowcake. Assuming a specific gravity of wet yellowcake of 1.346, the weight of the yellowcake contained in the hopper would be 30,740 pounds. Using the 35 weight percent slurry from the filter press, the weight of yellowcake powder in the hopper would be 10,759 pounds. This results in a total of 18,112 pounds of dry yellowcake available in the hopper and dryer for dispersion in the event of a fire or explosion.

NUREG/CR-6733 assumed that approximately 50 percent of the maximum yellowcake capacity available in two dryers and two hoppers would not be converted into aerosol size particles by the fire or explosion. Assuming this same factor for the Moore Ranch scenario, 9,056 pounds of yellowcake could become airborne. The volume of the Moore Ranch dryer room is approximately 7.37×10^4 ft^3.

NUREG/CR-6733 cites studies that indicate that the maximum sustainable airborne yellowcake concentration in air is 100 mg/m^3 (6.2×10^{-6} lb/ft^3), with heavier materials dropping out within a few minutes. Under the NUREG/CR-6733 scenario of 9,500 pounds of yellowcake dispersed in a dryer room with a volume of 1.2×10^5 ft^3, the average airborne yellowcake concentration for the first ten minutes was estimated at 3.8×10^{-2} lb/ft^3. This concentration resulted in a potential dose to a worker wearing respiratory protection (protection factor = 1,000) of 8.8 rem for the first ten minutes and 1.4 mrem for the second ten minutes after the heavier material had settled. This dose was based on Y class U_3O_8.

The average concentration of airborne uranium in the dryer room for the first ten minutes under the Moore Ranch scenario would be 6.16×10^{-2} lb/ft^3. Although this average concentration would result in a higher dose during the first ten minutes than that postulated under the NUREG/CR-6733 scenario, the uranium produced at Moore Ranch is expected to be D Class materials. This is particularly true of the 10,759 pounds contained in the hopper. For the sake of conservatism until samples of the actual Moore Ranch product can be analyzed for solubility, W Class uranium has been assumed in this application. W Class uranium would result in a dose lower than Y Class by a factor of 25. Although some of the dispersed material could be converted to Y Class depending on the temperature produced by the fire or explosion and the period of time that the material is exposed to that heat, it is clear that the dose under the Moore Ranch scenario would be less than that determined in NUREG/CR-6733.

NUREG/CR-6733 made the following recommendations due to the potentially severe consequences of a yellowcake dryer explosion:

- The checking and logging requirements contained in 10 CFR Part 40, Appendix A, Criterion 8 should be retained;

- Operators should train crews for response to an accident of this type;
- Dryer manufacturer maintenance and operations recommendations should be followed; and
- Respirators should be used in the area of the dryer when it is operating.

EMC will implement all of these recommendations at Moore Ranch.

7.5.2.4 Radiological Release Reporting

Reporting of releases of source or byproduct material will be consistent with the requirements of 10 CFR 20 Subpart M. These reporting requirements are discussed in detail in Section 5.2.6 of this Technical Report.

7.5.3 Groundwater Contamination Risk

7.5.3.1 Lixiviant Excursion

Excursions of lixiviant at ISR facilities have the potential to contaminate adjacent aquifers with radioactive and trace elements that have been mobilized by the mining process. These excursions are typically classified as horizontal or vertical. A horizontal excursion is a lateral movement of mining solutions outside the mining zone of the ore-body aquifer. A vertical excursion is a movement of solutions into overlying or underlying aquifers.

The historical experience at other ISR uranium operations indicates that the selected indicator parameters and UCLs allow detection of horizontal excursions early enough that corrective action can be taken before water quality outside the exempted aquifer boundary is significantly degraded. As noted in NUREG/CR-6733, significant risk from a horizontal excursion would occur only if it persisted for a long period without being detected.

Accident Prevention

EMC will control the lateral movement of lixiviant by maintaining well field production flow at a rate slightly greater than the injection flow. This difference between production and injection flow is referred to as process bleed. The bleed solution will either be recycled in the plant or sent to the liquid waste disposal system. When process bleed is properly distributed among the many mining patterns within the wellfield, mining solutions are contained within the monitor well ring.

EMC will monitor for lateral movement of lixiviant using a horizontal excursion monitoring system. This system consists of a ring of monitor wells completed in the same aquifer and zone as the injection and production wells. Monitor wells will be installed as discussed in Section 5.7.8. Monitor wells will be sampled biweekly for approved excursion indicators. Corrective actions will be taken if early signs of lixiviant migration are detected prior to reaching excursion status.

Vertical excursions can be caused by improperly cemented well casings, well casing failures, improperly abandoned exploration wells, or leaky or discontinuous confining layers. EMC will prevent vertical excursions through aquifer testing programs and rigorous well construction, abandonment, and testing requirements. Aquifer testing is conducted before mining wells are installed to detect any leaks in the confining layers. Aquifer test reports are submitted to the WDEQ for review and approval before well construction activities may proceed. Well construction and integrity testing will be conducted in accordance with WDEQ regulations and methods approved by NRC and WDEQ. Construction and integrity testing methods were discussed in detail in Section 3.1. Well abandonment is conducted in accordance with methods approved and monitored by the WDEQ and discussed in detail in Section 6.2.

EMC will monitor for vertical excursions in the overlying aquifer using shallow monitor wells. These wells will be located within the wellfield boundary at a density of one well per four acres. Shallow monitor wells will be sampled biweekly for approved excursion indicators. Corrective actions will be taken if early signs of lixiviant migration are detected prior to reaching excursion status.

<u>Mitigation\Accident Response</u>

Corrective actions and excursion response will be conducted as described in Section 5.7.8.

7.5.4 Wellfield Spill Risk

The rupture of an injection or recovery line in a wellfield, or a trunkline between a wellfield and the central plant, would result in a release of injection or production solution which would contaminate the ground in the area of the break. Small leaks in wellfield piping typically occur in the injection system due to the higher system pressures. These leaks seldom result in soil contamination.

Potential impacts to groundwater and surface water may occur during operations as a result of an uncontrolled release of process liquids due to a wellfield leak. Should an uncontrolled wellfield release occur, there would be a potential for contamination of the shallow aquifer as well as surrounding soil. With a slow leak that remains undiscovered or a short duration, high volume release, a shallow excursion is one potential impact. The potential impact to shallow groundwater from a slow, low volume leak occurring over a period of 18 months and a short duration, relatively high volume release are assessed in Addendum 7-1.

Spill Prevention

All piping from the central plant, to and within the wellfield will be buried for frost protection. Pipelines will be constructed of high density polyethylene (HDPE) with butt welded joints, or equivalent. All pipelines will be pressure tested at operating pressures prior to final burial and production flow and following maintenance activities that may affect the integrity of the system.

Each wellfield will have a number of headerhouses where injection and production wells will be continuously monitored for pressure and flow. Individual wells may have high and low flow alarm limits set. All monitored parameters and alarms will be observed in the control room via the computer system. In addition, each headerhouse will have a "wet building" alarm to detect the presence of any liquids in the building sump. High and low flow alarms have been proven effective in detection of significant piping failures (e.g., failed fusion weld).

Occasionally, small leaks at pipe joints and fittings in the headerhouses or at the wellheads may occur. Until remedied, these leaks may drip process solutions onto the underlying soil. EMC will implement a program of continuous wellfield monitoring by roving wellfield operators and will require periodic inspections of each well that is in service.

Mitigation/Spill Response

Following repair of a leak, EMC will require that the affected soil be surveyed for contamination and the area of the spill documented. If contamination is detected, the soil is sampled and analyzed for the appropriate radionuclides. Contamination may be removed as appropriate.

EMC will develop a response plan for wellfield spills that will include:

- Notification procedures

- Spill containment and recovery procedures
- Post spill sampling and cleanup procedures
- Reporting procedures

7.5.5 Transportation Accident Risk

Transportation of hazardous materials to and from the Moore Ranch Project can be classified as follows:

- Shipments of uranium-laden resin from the Moore Ranch Central Plant to a licensed facility for toll "milling" and return shipments of barren, eluted resin. Resin will be transported in tank trucks to a nearby licensed facility for elution, precipitation, and drying.

- Shipments of dried yellowcake. Yellowcake will be transported in 208-L (55-gal.) drums to a distant conversion facility for refining and conversion. Conversion facilities are currently located in Metropolis, Illinois and Port Hope, Ontario, Canada.

- Shipments of process chemicals or fuel from suppliers to the site.

- Shipment of radioactive waste from the site to a licensed disposal facility.

Accident risks involving potential transportation occurrences and mitigating measures are discussed in the following sections.

7.5.5.1 Accidents Involving Ion Exchange Resin Shipments

A potential transportation risk associated with operation of the Moore Ranch Project as a uranium extraction plant using toll "milling" at another licensed processing facility is the transfer of the ion exchange resin to and from the plant. Loaded ion exchange resin would be transported from the Moore Ranch Project in a 4,000 gallon capacity tanker trailer. It is currently anticipated that up to four loads of uranium-laden resin may be transported for elution and up to four loads of barren eluted resin may be returned on a daily basis. The transfer of resin will occur on a combination of private, county and State roads. For shipments of ion exchange resin to a central processing facility, NRC determined that the probability of an accident involving such a truck was 0.009 in any year[12].

Resin or eluate shipments will be treated similarly to yellowcake shipments in regards to Department of Transportation (DOT) and USNRC regulations. Shipments will be handled as Low Specific Activity (LSA) material for both uranium-laden and barren resin. General shipping procedures are outlined as follows:

- The resin, either loaded or eluted, will be shipped as "Exclusive Use Only". This will require the outside of each container or tank to be marked "Radioactive LSA" and placarded on four sides of the transport vehicle with "Radioactive" diamond signs.

- A bill of lading will be included for each shipment (including eluted resin). The bill of lading will indicate that a hazardous cargo is present. Other items identified shall be the shipping name, ID number of the shipped material, quantity of material, the estimated activity of the cargo, the transport index and the package identification number.

- Before each shipment of loaded or barren eluted resin, the exterior surfaces of the tanker will be surveyed for alpha contamination. In addition, gamma exposure rates will be obtained from the surface of the tanker and inside the cab of the tractor. All of the survey results will appear on the bill of lading.

<u>Accident Prevention</u>

Actions taken to prevent accidents involving shipments of ion exchange resins include the following:

- Properly licensed and trained drivers will transport the resin between the Moore Ranch Project and the toll "milling" facility.

- Trucks and tanker trailers used to transport ion exchange resins will be maintained in good operating condition.

- Inspections will be conducted of the Truck and tanker trailer prior to shipment of ion exchange resins. Transportation equipment will be taken out of service if any significant deficiencies are identified that could affect safe operation and transport and will not be place back into service until the deficiencies are corrected.

- Transport of ion exchange resin will only occur on maintained gravel or paved roads and will not occur during extreme or unsafe weather conditions.

Mitigation/Accident Response

EMC will develop an emergency response plan for transportation accidents to or from the Moore Ranch Project. EMC personnel will receive training for responding to a transportation accident. The emergency response plan will include descriptions of the following provisions:

- DOT Regulations
- Carrier Emergency Response Procedures
- Spill Kits
- Immediate Response and notification
- Accident Scene Response
- Spill cleanup
- Concluding Activities
- Review of Accident Documentation
- Review of Monitoring and Sampling Data
- Site Abandonment
- Reporting

The worst case accident scenario involving resin transfer transportation would be an accident involving the transport truck and tanker trailer when carrying uranium-laden resin where all of the tanker contents were spilled. Because the uranium is ionically-bonded to the resin and the resin is in a wet condition during shipment, the radiological and environmental impacts of such a spill are minimal. The radiological and environmental impact of a similar accident with barren, eluted resin would be less significant. The primary environmental impact associated with either accident would be the salvage of soils impacted by the spill area and the subsequent damage to the topsoil and vegetation structure. Areas impacted by the removal of soil would be revegetated.

In the event of a transportation accident involving the resin transfer operation, EMC will institute its emergency response plan for transportation accidents. To minimize the impacts from such an accident, the following procedures will be followed:

- Each truck will be equipped with a communication device that will allow the driver to communicate with either the shipper or receiver. In the event of an accident and spill, the driver will be able to communicate with either site to obtain help.

- A check-in and check-out procedure will be instituted where the driver will notify the receiving facility prior to departure from his location. If the resin shipment fails to appear within a set time, an emergency response team will respond and search for the vehicle. This system will assure reasonably quick response time in the case that the driver is incapacitated in the accident.

- Each resin transport vehicle will be equipped with an emergency spill kit which the driver can use to begin containment of any spilled material. The kit will include plastic sheeting to cover spilled material until cleanup operations can begin.

- Both the shipping and receiving facilities will be equipped with emergency response kits to quickly respond to a transportation accident.

- Personnel and truck drivers will have specialized training to handle an emergency response to a transportation accident.

7.5.5.2 Accidents Involving Yellowcake Shipments

NUREG-0706 concluded that the probability of a truck accident involving shipments of yellowcake in any year is 11 percent for each uranium extraction facility. This calculation used average accident probabilities (4.0 x 10^{-7}/km for rural interstate, 1.4 x 10^{-6}/km for rural two-lane road, and 1.4 x 10^{-6}/km for urban interstate) that NUREG/CR-6733 determined were conservative.

As with resin shipments, yellowcake shipments will be made in accordance with DOT and USNRC regulations. Shipments will be handled as Low Specific Activity (LSA) material and will follow the same general shipping procedures as outlined for ion exchange resin shipments in Section 7.5.5.1.

Accident Prevention

Actions taken to prevent accidents involving shipments of yellowcake include the following:

- Properly licensed and trained drivers will transport the yellowcake between the Moore Ranch Project and the toll "conversion" facility.

- Trucks and trailers used to transport ion exchange resins will be maintained in good operating condition.

- Inspections will be conducted of the Truck and trailer prior to shipment of yellowcake. Transportation equipment will be taken out of service if any significant deficiencies are identified that could affect safe operation and transport and will not be place back into service until the deficiencies are corrected.

- Transport of yellowcake will only occur on maintained gravel or paved roads and will not occur during extreme or unsafe weather conditions.

Mitigation/Accident Response

EMC will develop an emergency response plan for yellowcake and other transportation accidents to or from the Moore Ranch Project. EMC personnel will receive training for responding to a transportation accident. The emergency response plan will include descriptions of the following provisions:

- DOT Regulations
- Carrier Emergency Response Procedures
- Spill Kits
- Immediate Response and notification
- Accident Scene Response
- Spill cleanup
- Concluding Activities
- Review of Accident Documentation
- Review of Monitoring and Sampling Data
- Site Abandonment
- Reporting

The worst case accident scenario involving yellowcake transportation would be an accident involving the transport truck where the integrity of one or more drums containing yellowcake was breached, resulting in a release to the environment. Unlike ion exchange resin shipments, ISR operators do not typically transport their own yellowcake to conversion facilities but rather contract with transport companies that specialize in shipments of yellowcake. These companies have extensive emergency response programs including spill response equipment on board, drivers trained in radiological emergency response, constant monitoring of truck location and operating parameters, and standing contracts with environmental emergency response contractors for cleanup of spills. As with ion exchange resin, the primary environmental impact associated with an accident involving the spill of yellowcake would be the salvage of soils impacted by the spill area and the subsequent damage to the topsoil and vegetation structure. To minimize the impacts from such an accident, the following procedures will be followed:

- Each truck will be equipped with a communication device that will allow the driver to communicate with either the shipper or receiver. In the event of an accident and spill, the driver will be able to communicate with either site to obtain help.

- A check-in and check-out procedure will be instituted where the driver will notify the receiving facility prior to departure from his location. If the resin shipment fails to appear within a set time, an emergency response team will respond and search for the vehicle. This system will assure reasonably quick response time in the case that the driver is incapacitated in the accident.

- Each yellowcake transport vehicle will be equipped with an emergency spill kit which the driver can use to begin containment of any spilled material. The kit will include plastic sheeting to cover spilled material until cleanup operations can begin.

- Both the shipping and receiving facilities will be equipped with emergency response kits to quickly respond to a transportation accident.

Personnel and truck drivers will have specialized training to handle an emergency response to a transportation accident.

7.5.5.3 Accidents Involving Shipments of Process Chemicals

It is estimated that approximately 4 bulk chemical, fuel, and supply deliveries will be made per working day throughout the operational life of the project. Types of deliveries will include carbon dioxide, oxygen, salt, soda ash, hydrogen peroxide, sodium hydroxide, sulfuric and\or hydrochloric acid, and fuel. All shipments will be made in accordance with the applicable DOT hazardous materials shipping provisions.

7.5.5.4 Accidents Involving Radioactive Wastes

Low level radioactive 11(e).2 by-product material or unusable contaminated equipment generated during operations will be transported to a licensed disposal site. Because of the low levels of radioactive concentration involved, these shipments are considered to have minimal potential environmental impact in the event of an accident. Shipments are generally made bulk in sealed roll off containers in accordance with the applicable DOT hazardous materials shipping provisions and will follow the same general shipping procedures, accident prevention, mitigation, and accident response outlined for ion exchange resin and yellowcake shipments.

7.5.6 Fires and Explosions

The fire and explosion hazard of the CPP will be minimal as the plant does not use flammable liquids in the recovery process and building and equipment materials are largely made up of non-flammable materials such as steel or concrete.. Natural gas used for building heat would be the primary source for a potential fire or explosion. In the CPP the uranium will be in solution, adsorbed on ion exchange resin, wet yellowcake slurry, or as a dried yellowcake powder contained in a sealed drum or the vacuum dryer. An explosion, therefore, would not appreciably disperse the uranium to the environment.

In the wellfields, injection and recovery well piping systems are manifolded for ease of operational control. Piping manifolds, submersible pump motor starters/controllers, and gaseous oxygen delivery systems are situated within electrically heated, all weather buildings. These are commonly referred to as "Headerhouses". An accumulation of gaseous oxygen would be the primary source for a potential fire or explosion. Such an event could result in the rupture of a leaching solution pipeline within the building and a spill of leaching solution.

Fire Prevention

Prevention methods utilized to minimize potential impacts to human health and the environment from fire or explosion scenarios discussed above include the following:

- Spilled liquids or slurries would be confined to the building sump or to the runoff control system.
- The sealed drums and vacuum dryer at Moore Ranch would contain the dried yellowcake powder, and any potential releases would be contained within the Dryer Building.
- Both the gaseous oxygen and primary leaching solution lines entering each headerhouse are equipped with automatic low pressure shut off valves to minimize the delivery of oxygen to a fire or of liquids to a spill.
- Additionally, each Headerhouse is equipped with a continuously operating exhaust fan that would assist in preventing the build-up of oxygen in the building.
- Procedures will be in place for confined space work or hot work for monitoring of oxygen build-up prior to start of work.

Mitigation/Emergency Response

Automatic detection and alarm systems along with sprinkler systems will be installed in the central plant and other facilities at the Moore Ranch Project. Fire extinguishers will be placed at accessible locations in all buildings and vehicles for quick response and training will be provided for appropriate personnel in use of fire extinguishers. EMC personnel will receive training for responding to a fire or explosion. The emergency response plan will include descriptions of the following provisions:

- Notification and evacuation procedures
- Personal protective equipment
- General fire fighting safety rules
- Reporting procedures
- Electrical and gas emergencies

7.5.7 Accident Risk Associated with Coal Bed Methane Development

The presence of CBM development on the Moore Ranch Project site presents accident risks that are not commonly associated with ISR mining. These additional accident risks, the control methods that the CBM operators currently have in place, additional control measures proposed by EMC, and the potential effect of accidents on the health and safety of EMC employees and the public and the security of licensed material are discussed in the following sections. The potential accident scenarios that could impact EMC operations are based on those analyzed by the BLM in the 2003 FEIS for the Powder River Basin.

7.5.7.1 Methane Migration and Seepage

CBM development includes potentially increased risks of methane seepage, fires, or explosions. Methane is not biologically toxic, but high concentrations in confined spaces can displace oxygen and present a danger of fire or explosion.

Methane gas can reach the surface by naturally occurring seepage along fault lines, fractures, or sandstone layers in areas where coal beds are shallow. Gas migration could also be enhanced during CBM development in areas along a coal outcrop, which are not present on the Moore Ranch site. Non-CBM wells that penetrate the coal seam may provide pathways for migration of methane if the casings or plugs are inadequate or faulty or lack isolation through the coal horizons.

BLM reported in the 2003 FEIS that experience in the Powder River Basin has shown that few cases of methane seeps that involve potentially explosive concentrations of gas have occurred.

Accident Prevention

The potential for migration of methane in CBM wells is minimized or prevented by the use of the current CBM industry standards for cementing and casing wells that isolate or protect all zones from gas or fluid migration. Well construction methods for CBM wells were discussed in detail in Section 7.2.9.1.

Mitigation

Risks from methane associated with oil and gas wells, including CBM wells, are controlled through the BLM-mandated conditions of approval for the Application for Permit to Drill (APD) that address well conditions, casing, ventilation, and plugging procedures appropriate to site-specific CBM development plans. In addition, CBM operators must have emergency plans and employee training programs that address fire prevention and control measures.

7.5.7.2 Pipeline Ruptures

CBM development involves the potential for leaks or ruptures of gas flowlines or pipelines. Most ruptures occur when heavy equipment accidentally strikes the pipeline while operating in close proximity. These ruptures may result in a fire or explosion if a spark or open flame ignites the escaping gas.

The projected development area of the Moore Ranch Project includes approximately 2,100 feet of gas pipeline. Based on a statistical average of one significant safety incident per year per 4,154 miles of total pipeline[13], 0.0001 additional pipeline safety incidents (including ruptures) may occur within the license area per year over the life of the project.

Based on the low incident rate, location of pipelines, and the preventative measures planned for the Moore Ranch Project, there is an insignificant increase in risks to human health and safety and control of licensed material associated with potential pipeline ruptures from CBM-related facilities.

Accident Prevention

Materials used in the pipelines are designed and selected in accordance with applicable standards to minimize the potential for a leak or rupture. Pipeline markers are posted at frequent intervals along the pipelines to warn excavators and to reduce the risk of accidental rupture from excavating equipment. EMC will work with CBM operators located on the proposed license area to ensure that all gas collection and transmission lines within proposed development areas are adequately marked to prevent accidental rupture by EMC activities.

Mitigation

The CBM operators monitor the pipeline flows by either remote sensors or daily inspections of the flow meters. Routine monitoring reduces the probability of effects to health and safety from ruptures by facilitating the prompt detection of leaks. If pressure losses are detected, the wells are shut in until the problem is isolated and addressed. Accident response will be similar to what is described above in Section 7.5.6 (Fire and Explosions).

7.5.8 Natural Disaster Risk

NUREG/CR-6733 considered the potential risks to an ISR facility from natural disasters. Specifically, the risk from an earthquake and a tornado strike were analyzed. NRC determined that the primary hazard from these natural events was from dispersal of yellowcake from a tornado strike and failure of chemical storage facilities, resulting in the possible reaction of process chemicals. NUREG/CR-6733 recommended that licensees follow industry best practices during design and construction of chemical facilities. EMC is committed to following these standards.

The Moore Ranch Project is located in Campbell County Wyoming, in which 69 tornadoes touch downs were recorded in a period from 1950 through 2003[14]. Of those, 65 tornadoes were classified as F0 (with wind speeds of 40-72 miles per hour and described as a gale tornado) or F1 tornadoes (described as moderate with wind speeds of 73-112 miles per hour). Four of the 69 tornadoes were classified as F2 with wind speeds of 113-157 miles per hour and described as significant tornadoes. Based on the Fujita Scale, the type of damage that can be expected from an F2 tornado is roof damage, unsecured mobile homes pushed off foundations, and light structures severely damaged or destroyed. Based on maximum wind speed probability, the eastern third of the state can expect a tornado between 10,000 and 100,000 years,

NUREG-0706 estimated the probability of occurrence of a tornado in the area in which the project is located is about 3×10^{-4} per year. The area was categorized as Region 3 in relative tornado intensity. For this category, the wind speed of the design tornado was 240 mph (F4 tornado), of which 190 mph is rotational and 50 mph is translational. The Moore Ranch structures are not designed to withstand a tornado of this intensity.

The nature of the operation is such that little more could be done to secure the facility with advance warning than without it. NUREG-0706 postulated a "no warning" tornado. It was conservatively assumed that a maximum inventory of 50 short tons of yellowcake was onsite when the tornado strikes, and that 15% of the contained material was released. In this analysis, NRC assumed that the tornado lifts about 25,100 lb of yellowcake (equivalent to the contents of twenty-six 55-gallon drums). The conservative model assumed that all of the yellowcake was in a respirable form, was entrained as the vortex passed over the site and upon reaching the site boundary, was dispersed by the trailing winds. The model predicted a maximum exposure at a distance of approximately 2.5 miles from the mill, where the 50-year dose commitment to the lungs of an individual was estimated to be 8.3×10^{-7} rem (0.8 mrem). NUREG/CR-6733 reviewed this model scenario and found it to be valid for ISR operations.

Mitigation and Emergency Response

NUREG/CR-6733 concluded that tornado risk is very low at uranium ISR facilities and that no design or operational changes were required to mitigate the risk. One recommendation was that chemical storage tanks be located sufficiently far apart that leaks caused by tornado damage would not result in chemical reactions. EMC will institute procedures and provide instructions to operating personnel for response and mitigation of natural disasters and any associated spills of radioactive materials. Emergency response procedures will include:

- Notification to personnel of potential severe weather
- Evacuation procedures
- Damage inspection and reporting
- Cleanup and mitigation of spills of radioactive materials or chemicals

7.6 ECONOMIC AND SOCIAL EFFECTS OF CONSTRUCTION AND OPERATION

7.6.1 Construction

The construction phase would cause a moderate impact to the local economy, resulting from the purchases of goods and services directly related to construction activities. Impacts to community services in rural Campbell County or the nearby towns of Midwest and Edgerton in Natrona County, and Wright in Campbell County, such as roads, housing, schools, and energy costs would be minor or non-existent and temporary.

An estimated 50 percent (25 workers) of the construction work force would be based in Campbell County, which contains the Project site. The workforce hired outside of the County would likely be based in Casper, located in the neighboring Natrona County, as Casper is a regional economic hub that provides a variety of construction services and labor for projects located throughout Wyoming.

Most construction work available to the local construction labor pool consists of temporary contract work that varies in duration, depending on the scope of each construction project. Further, the number of unemployed construction workers does not represent the number of workers that would be available to the proposed project from the local construction labor pool. The number is an annual average that does not take into account monthly variations in the available construction labor pool from construction start-ups and completions. Contractors for projects located throughout northeastern Wyoming typically hire from the local construction labor pool. The actual number of construction workers available for the proposed project would potentially draw from the entire construction labor pool of 6,268 (2005 estimate; the construction labor pool as of 2007 is likely to be larger), as construction activities from some active projects would conclude so that workers would be available for future projects.

7.6.2 Operations Workforce

An estimated 40 to 60 people would be required for the operation of the proposed Moore Ranch Project. It is not known how many of the required operations workforce would be hired from outside of Campbell and Natrona Counties. In the event that the entire operations workforce and their families relocated to the counties, the population increase would be a maximum of 150, based on the 2005 average household size of 2.52 in Wyoming. This increase would account for 0.1 percent of the population of Campbell and Natrona Counties, and is smaller than the projected annual growth rate. Therefore, there would be little to no effect to the vacancy rates of any type of housing in Gillette area or Campbell County.

7.6.3 Effects to Housing

The Moore Ranch License Area lies within commuting distance of Gillette and Wright, in Campbell County; and Casper in Natrona County, so that workers from these counties would likely commute from their homes. There would be no impact to temporary housing located within commuting distance (an estimated 1 to 2 hours) of the License Area.

In the event that workers from outside the local area are hired for construction, temporary housing such as motel/hotel rooms and RV sites located within commuting distance would be required, as no on-site housing (man camp) would be available. The available stock of motel/hotel rooms would accommodate relocating workers.

It is recognized, however, that the coal bed methane gas and mineral industries are presently a dominating factor for temporary housing availability in the area, and the workforce employed in these industries occupy much of the temporary housing that becomes available.

It is anticipated that few of the construction work force during any phase of the proposed Project would purchase or rent housing of any type. Therefore, there would be no effects on the costs of any type of housing in the counties. Because rental housing usually require a long-term lease (generally a minimum of 6 months), only operations employees would likely enter into this type of lease agreement. Under a hiring scenario that assumes all of the proposed operations workforce would need to relocate to the area, 40 to 60 housing units would be required over the life of the project. In 2006, there were a total of 60 vacant housing units in Campbell and Natrona Counties, which would not meet the future demand for housing in the counties from anticipated population growth. Therefore, there would be little to no effect to the rental rates of any type of housing in Gillette or Campbell County.

Household projections estimate an increase in households from 2000 to 2030 as 140 percent in Campbell County and 73 percent in Natrona County. The existing housing stock would not accommodate the projected households. Local communities in general are aware of the pressing need for the new residential development.

7.6.4 Effects to Services

It is likely that both the construction and operating work force would be from the Campbell and Natrona Counties, or other nearby counties in northeast Wyoming, and would not require permanent or temporary housing. In the event that up to 50 percent of the construction and operating workforce are non-local workers, it is anticipated that there would be a less than one percent increase in the population of Campbell and Natrona Counties from the permanent relocation of the workers and their families. Most non-local workers would utilize temporary housing. Because existing mobile home and RV parks will be used for a majority of the temporary housing, the Project will not require new water, sewer, electrical lines, or other infrastructure. There will be no additional demands of increases in service levels for local infrastructure, such as police, fire, water, or utilities. In addition, there would be little measurable increase in non-basic employment, as these jobs are generated from ongoing employment of the existing base of construction workers, and would be maintained through the continued employment of local construction workers. Therefore, construction and operation of the Project would not significantly affect the various public and non-public facilities and services described above from the in-migration of workers for non-basic employment opportunities.

7.6.5 Effects to Traffic

The most heavily used public road segment would be State Highway 387 between I-25 to the west and State Highway 59 to the east. Access to Moore Ranch from Gillette would be from State Highway 59, and from Casper would be from I-25; traffic would converge on Moore Ranch on State Highway 387 from the east and the west. Existing average daily traffic volumes for the local highways in the project area, State Highways 50, 59 and 387 are shown in Table 7.6-1 (WYDOT, 2009). The traffic information includes data from years 1997, 2006 and 2007. Additionally, for the year 2007, the table breaks down the truck traffic by percentage of the total traffic volume recorded. A map of the subject and regional roadways and communities is shown in Figure 7.6-1.

Projected daily truck and auto traffic volume data for the three local State Highways during the construction, operation, restoration and decommissioning phases of the project is also presented in Table 7.6-1. The projected increases of vehicle traffic resulting from the project activities are calculated for each local highway segment being subjected to the total increase in traffic. This vehicle traffic increase calculation allows for the analysis of the maximum amount of traffic that could be expected for each local highway. Truck traffic includes trucks that haul heavy equipment (cranes, bulldozers, graders, track hoes, trenchers, front-end loaders, etc.) to the construction site, and haul the facilities and equipment during the construction phase of the project. During the operational and restoration phases of the project, truck traffic includes yellowcake shipments, radioactive by-product waste and non-radioactive waste shipments, and regular operation deliveries. During the decommissioning phase, truck traffic includes hauling of equipment and facilities, and both radioactive and non-radioactive waste. The average daily estimated increase in auto traffic is based on the workforce level, which varies depending upon the phase of the project. Auto traffic includes passenger vehicles, light duty trucks or other personal or work vehicles used to transport personnel to the project site. During the operational and restoration phases of the project there will be a peak workforce of 24 employees which equates to a maximum average of 48 auto trips per day using the assumption of one employee per vehicle per one-way vehicle trip.

Using these vehicle traffic projections and recent data supplied by WYDOT for the year 2007, the highest levels of project-related traffic would be from the truck traffic occurring during the construction phase of the project, when there could be an increase of 4.8 percent in daily truck traffic. The highest auto (non-truck) traffic increase related to the project may occur during the operational and restoration phases when a 2.5 percent average increase in daily auto trips could occur. The 4.8 percent increase in truck traffic and 2.5 percent increase in average daily auto traffic is well below the 25 percent threshold generally used for predicting significant effects to a transportation system, and the subsequent potential for an impact on wildlife will be minimal.

Transportation of dried yellowcake would be made in exclusive-use transport vehicles to a licensed conversion facility in Metropolis, Illinois for further processing. The proposed annual production rate for the Moore Ranch Project is 4 million pounds of yellowcake. Based on weight limits for legal transport, each shipment will contain approximately 40,000 pounds of yellowcake, resulting in a total of 100 shipments of yellowcake per year, or an average of one shipment every 3.6 days. This level of traffic would not significantly affect the project-related traffic compared to the commuting traffic associated with the project workforce.

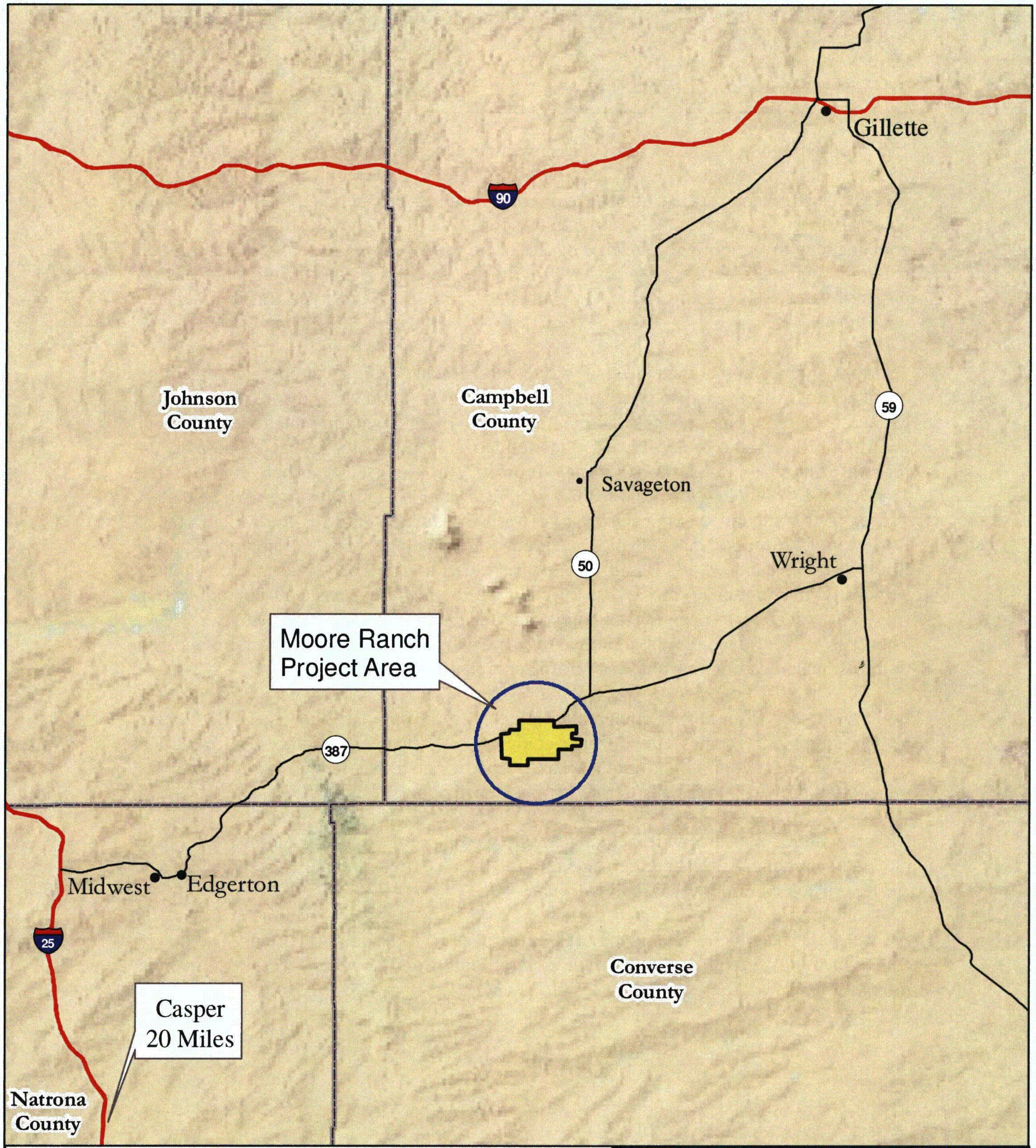
Transportation of 11(e).2 byproduct material will be made in exclusive-use transport vehicles to a licensed disposal facility. Although a final disposal agreement is not in place, the preferred alternative disposal site is the Pathfinder Mines Corp. (PMC) Shirley Basin facility due to proximity to the Moore Ranch site. The Shirley Basin facility is located approximately 132 highway miles from the Moore Ranch Project. The expected transport route to the PMC facility will be west on State Highway 387, south on Interstate 25, west on State Highway 220, and south on State Highway 487 to the PMC facility access road. The expected annual byproduct material production rate for the Moore Ranch Project is approximately 100 cubic yards. Based on the use of covered roll-off containers with a nominal capacity of 20 cubic yards, EMC expects five byproduct material shipments per year. This level of traffic would not significantly increase the project-related traffic compared to the estimated commuting and truck traffic associated with the project.

Transportation of nonradioactive solid waste will be made using a contract waste hauling company to a licensed disposal facility. The preferred alternative disposal site is the Midwest-Edgerton No. 2 disposal site located in Midwest, Wyoming due to proximity to the Moore Ranch site. The Midwest-Edgerton No. 2 facility is located approximately 24 highway miles from the Moore Ranch Project. The expected transport route to the Midwest-Edgerton No. 2 disposal facility will be west on State Highway 387 to Midwest. The expected annual nonradioactive solid waste production rate for the Moore Ranch Project is 2,000 cubic yards. Typical contract waste haulage vehicles range in capacity from 20 to 40 cubic yards. Based on a conservative assumption of the use of haulage vehicles with a nominal capacity of 20 cubic yards, EMC expects 100 nonradioactive solid waste shipments per year, or an average of approximately 2 shipments per week. This level of traffic would not significantly increase the project-related traffic compared to the estimated commuting and truck traffic associated with the project.

Equipment needed for construction and installation of the proposed facility would include heavy equipment (cranes, bulldozers, graders, track hoes, trenchers, and front-end loaders), and heavy- and light-duty trucks. It is anticipated that heavy equipment will be transported primarily to the site during off-peak traffic hours.

On-site road maintenance will include periodic grading of the primary access roads, snow plowing, applying water or other agent(s) for dust control, and regular inspections to ensure erosion control measures are adequate.

All wellfield roads will be removed at the time of project decommissioning. The newly constructed gravel road that leads to the Central Plant from the main access road (shown in Figure 7.6-2) will be left in place for future use.



Legend

- Moore Ranch Project Area
- County Boundary
- 2 mile buffer

N

0 2.5 5 10 Miles

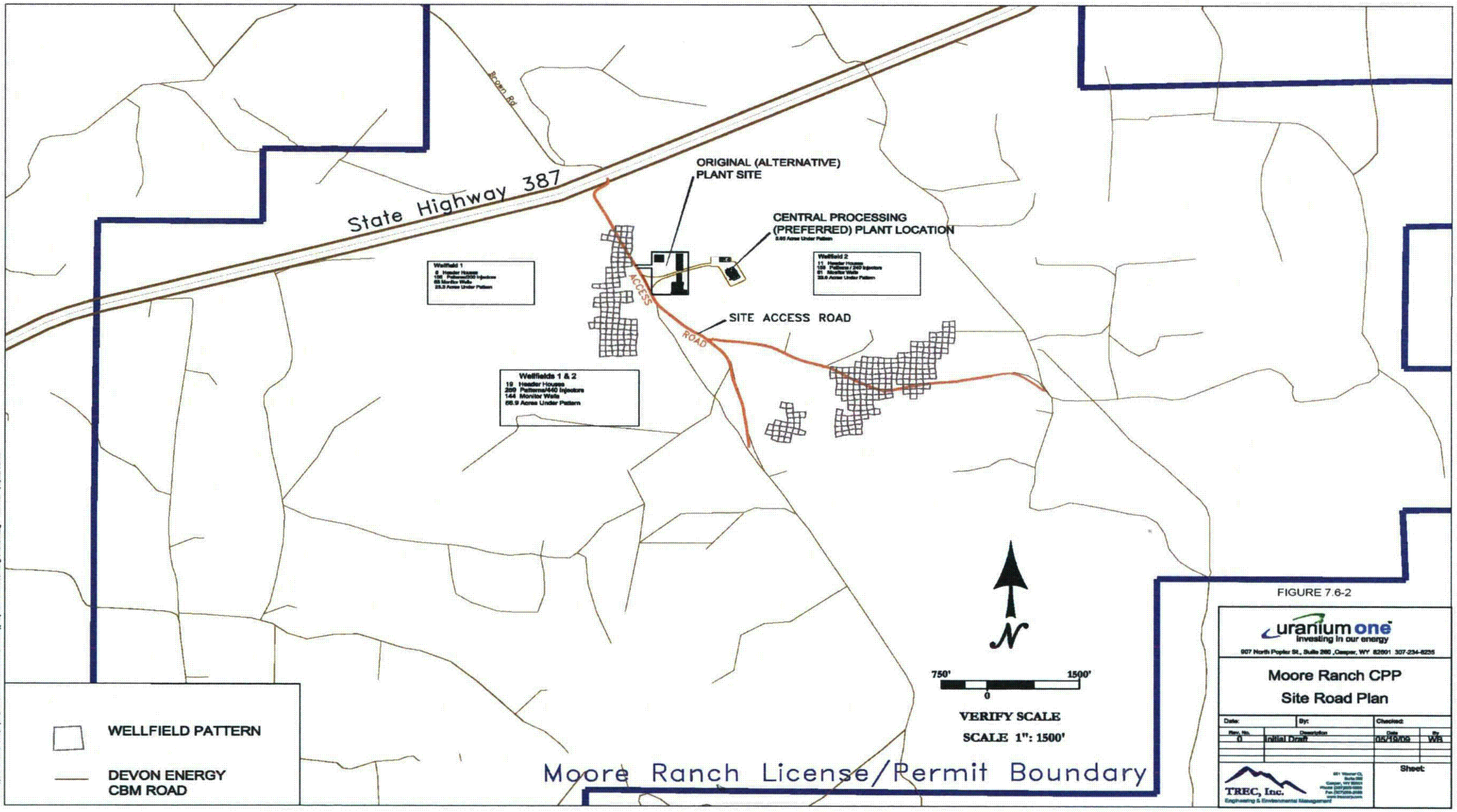
Source: Wyoming Geographic Information Science Center

Figure _____
MOORE RANCH URANIUM PROJECT
Local Highways

uraniumone
investing in our energy

TREC, Inc.
Engineering & Environmental Management
951 Werner Court
Suite 395
Casper, WY 82601
www.treccorp.com
Phone (307) 265-0696
Fax (307) 265-2498

Figure 7.6-2- Central Processing Plant Site Road Plan



7.6.6 Economic Impact Summary

Economic impacts are summarized in the benefit-cost analysis in Section 9.

7.7 ENVIRONMENTAL JUSTICE

The U.S Census 2000 Decennial Population program provides race and poverty characteristics for Census Tracts and Block Groups, which are subdivisions of Census Tracts. The Moore Ranch License Area and the surrounding 2-mile buffer are contained within five Census Tracts and one additional Block Group that encompass portions of Campbell, Converse, Johnson, and Natrona Counties.

As summarized in Table 7.7-1, the combined population of the surrounding Census Tracts was 4,799. Minority populations accounted for a small percentage of the total population, with percentages of minorities generally similar to or smaller than those of the state as a whole.

The State of Wyoming was selected to be the geographic area to compare the demographic data for the population in the affected Census Tracts. This determination was based on the need for a larger geographic area encompassing affected area Census Tracts in which equivalent quantitative resource information is provided. The population characteristics of the affected Census Tracts are compared with Wyoming population characteristics to determine whether there are concentrations of minority or low-income populations in the Census Tracts relative to the state.

The data in Table 7.7-1 show that minority populations in the affected Tracts account for an overall smaller proportion of the population than the proportion of minority populations at the state level. No concentrations of minority populations were identified as residing near the proposed Project facilities, as residents nearest to the Moore Ranch Area are rural populations, while most of the minority population lives in Gillette and communities along the I-25 corridor to the south. There would be no disproportionate impact to minority population from the construction and implementation of the Moore Ranch Project.

With the exception of Census Tracts 9551 in Johnson County and 14.01 in Natrona County, the populations within the Tracts exhibit lower rates of people living below the poverty level than the state. Census Tracts 9551 and 14.01 contain rural populations; therefore, there is no concentration of people living below the poverty level in these Tracts. No disproportionate adverse environmental impacts would occur in populations living below the poverty level within the Census Tracts from proposed Project activities.

Table 7.7-1 Race and Poverty Level Characteristics of the Population in the Moore Ranch Permit Area Census Tracts

	State of Wyoming	Percent of Total State Population	Census Tract 1, Campbell County	Percent of Census Tract 1	Census Tract 9566, Converse County	Percent of Census Tract 9566	Block Group 1, Census Tract 9566, Converse County	Percent of Block Group 1, Census Tract 9566	Census Tract 9551, Johnson County	Percent of Census Tract 9551	Census Tract 14.01, Natrona County	Percent of Census Tract 14.01	Census Tract 18, Natrona County	Percent of Census Tract 18	Total
Total	493,782	100.0	4,779	100.0	2,944	100.0	1,412	100.0	1,918	100.0	3,478	100.0	3,285	100.0	**17,816**
Urban:	322,073	65.2	418	8.7	0	0.0	0	0.0	0	0.0	0	0.0	9	0.3	**427**
Inside urbanized areas	125,706	25.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	9	0.3	**9**
Inside urban clusters	196,367	39.8	418	8.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	**418**
Rural	171,709	34.8	5,615	117.5	2,944	100.0	1,412	100.0	1,918	100.0	3,478	100.0	3,276	99.7	**18,643**
White alone	454,095	92.0	4,671	97.7	2,805	95.3	1,331	94.3	1,877	97.9	3,284	94.4	3,150	95.9	**17,118**
Black or African American alone	3,126	0.6	1	0.0	6	0.2	3	0.2	1	0.1	11	0.3	8	0.2	**30**
American Indian and Alaska Native alone	11,363	2.3	22	0.5	18	0.6	13	0.9	8	0.4	41	1.2	45	1.4	**147**
Asian alone	2,972	0.6	4	0.1	12	0.4	5	0.4	3	0.2	8	0.2	6	0.2	**38**
Native Hawaiian and Other Pacific Islander alone	232	0.0	2	0.0	1	0.0	1	0.1	0	0.0	8	0.2	2	0.1	**14**
Some other race alone	12,595	2.6	24	0.5	60	2.0	46	3.3	11	0.6	47	1.4	28	0.9	**216**
Two or more races	9,399	1.9	55	1.2	42	1.4	13	0.9	18	0.9	79	2.3	46	1.4	**253**
People who are Hispanic or Latino	31,384	6.4	88	1.8	113	3.8	73	5.2	52	2.7	106	3.0	78	2.4	**510**
Median household income in 1999	37,892	-	55,233	-	47,250	-	44,821	-	40,053	-	38,629	-	45,481	-	na
Per capita income in 1999	19,134	-	21,886	-	22,673	-	19,598	-	20,595	-	15,601	-	21,084	-	na
Population with income in 1999 below poverty level:	54,777	-	398	-	157	-	85	-	241	-	571	-	191	-	**1,643**
Percent below poverty level	11.1%	-	8.3%	-	5.3%	-	6.0%	-	12.6%	-	16.4%	-	5.8%	-	**9.2%**

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8 ALTERNATIVES TO PROPOSED ACTION

8.1 NO-ACTION ALTERNATIVE

Under the provisions of the National Environmental Policy Act (NEPA), one alternative that must be considered in each environmental review is the no-action alternative. In this case, the no-action alternative would mean that the NRC would not approve the Moore Ranch application and would not issue a Materials License. ISR uranium mining would not occur in the Moore Ranch area and the associated environmental impacts would not occur.

8.1.1 Impacts of the No-Action Alternative

The no-action alternative would result in significant financial impacts to EMC and to Campbell County, Wyoming and the surrounding area. EMC has invested significant resources to develop the Moore Ranch Uranium Project that would be irretrievably lost under the no action alternative. In addition, the no action alternative would adversely affect the economic growth of Campbell County. As discussed in further detail in Section 9, the Moore Ranch Uranium Project is expected to provide a significant economic impact to the local economy.

A decision to not issue a Materials License to EMC would leave a large resource unavailable for energy production supplies. Although EMC is continuing to develop estimates of the reserves at Moore Ranch, the current estimated resource is 5.8 million pounds U_3O_8.

In 2006, total domestic U.S. uranium production was approximately 4.7 million pounds U_3O_8[1]. During the same year, domestic U.S. uranium consumption was approximately 67 million pounds U_3O_8[2]. The Moore Ranch project represents an important new source of domestic uranium supplies that are essential to provide a continuing source of fuel to power generation facilities.

In addition to leaving a large deposit of valuable mineral resources untapped, a denial of this license application would result in adverse economic affects on the individuals that have surface leases with EMC and own the mineral rights in the Moore Ranch Project Area.

8.2 PROPOSED ACTION

The proposed Moore Ranch Uranium Project contains a licensed area of approximately 7,110 acres. Of this potential licensed area, the surface area to be affected by mining operations will be less than 150 acres for the central plant and facilities including the wellfields. The Moore Ranch Uranium Project is located in Campbell County, Wyoming within Township 42 North, Range 75 West, Sections 26, 27, 33, 34, 35, 36 and Township 41 North, Range 75 West, Sections 1, 2, 3, and 4, and Township 42 North, Range 74 West, Section 31 between the towns of Wright and Edgerton with access to the project site from Wyoming State Highway 387. The proposed action will consist of construction, operation, and ultimately decommissioning of wellfields, an ion exchange facility, wastewater disposal well(s), and a processing and drying facility.

Commercial production of the reserves at the Moore Ranch Project and subsequent groundwater restoration activities are projected to extend over the next ten years. The minimum projected life of the central plant is projected to be 25 years since EMC plans to use the facility to process ion exchange resin from satellite facilities operated by EMC or others. Aquifer restoration and reclamation at Moore Ranch will be accomplished concurrent with operations to the extent feasible plus an additional two years at the end of the project for final decommissioning of the central plant facilities and surface reclamation in these areas. More detailed schedules were provided in Section 1.

The in-situ process consists of an oxidation step and a dissolution step. The oxidants utilized in the facility are hydrogen peroxide and/or gaseous oxygen. A sodium bicarbonate lixiviant is used for the dissolution step. The uranium-bearing solution is recovered from the wellfield and piped to the central plant for extraction. The central plant process utilizes the following steps:

- Loading of uranium complexes onto an ion exchange resin;
- Reconstitution of the solution before reinjection by the addition of sodium bicarbonate and oxygen;
- Elution, precipitation, drying, and packaging of yellowcake in the central plant; and
- Restoration of groundwater following mining activities.

The operation of the Moore Ranch Project will result in a number of effluent streams. Airborne effluents are limited to the release of radon-222 gas during the uranium recovery process. Liquid wastes are handled through deep well injection.

Groundwater restoration activities consist of three steps:

- Groundwater transfer;
- Groundwater sweep; and
- Groundwater treatment;

Groundwater restoration will take place concurrently with development and production activities. The goal of groundwater restoration will be to return the concentration of a hazardous constituent in the production zone to an NRC-approved background concentration or to the maximum concentration limit (MCL), whichever is higher, or to an alternate standard approved by NRC using Best Practicable Technology.

Following groundwater restoration activities, all injection and recovery wells will be reclaimed using appropriate plugging and abandonment procedures. In addition, a sequential land reclamation and revegetation program will be implemented on the site. This reclamation will be performed on all disturbed areas, including the plant, wellfields, ponds and roads.

EMC will maintain financial responsibility for groundwater restoration, plant decommissioning and surface reclamation. Financial surety is discussed in Section 6.

The environmental impacts of the requested action will be minimal as discussed in Section 7. The only radiological air impacts will be from the release of radon gas during production. The release of radon will be minimized by the use of pressurized downflow ion exchange columns. In addition, radon gas quickly dissipates in the atmosphere and results in a minimal additional exposure to the public as discussed in Section 7. All drying and packaging performed at the Moore Ranch Central Plant will use a vacuum drying system, so there are no additional radioactive air particulate releases.

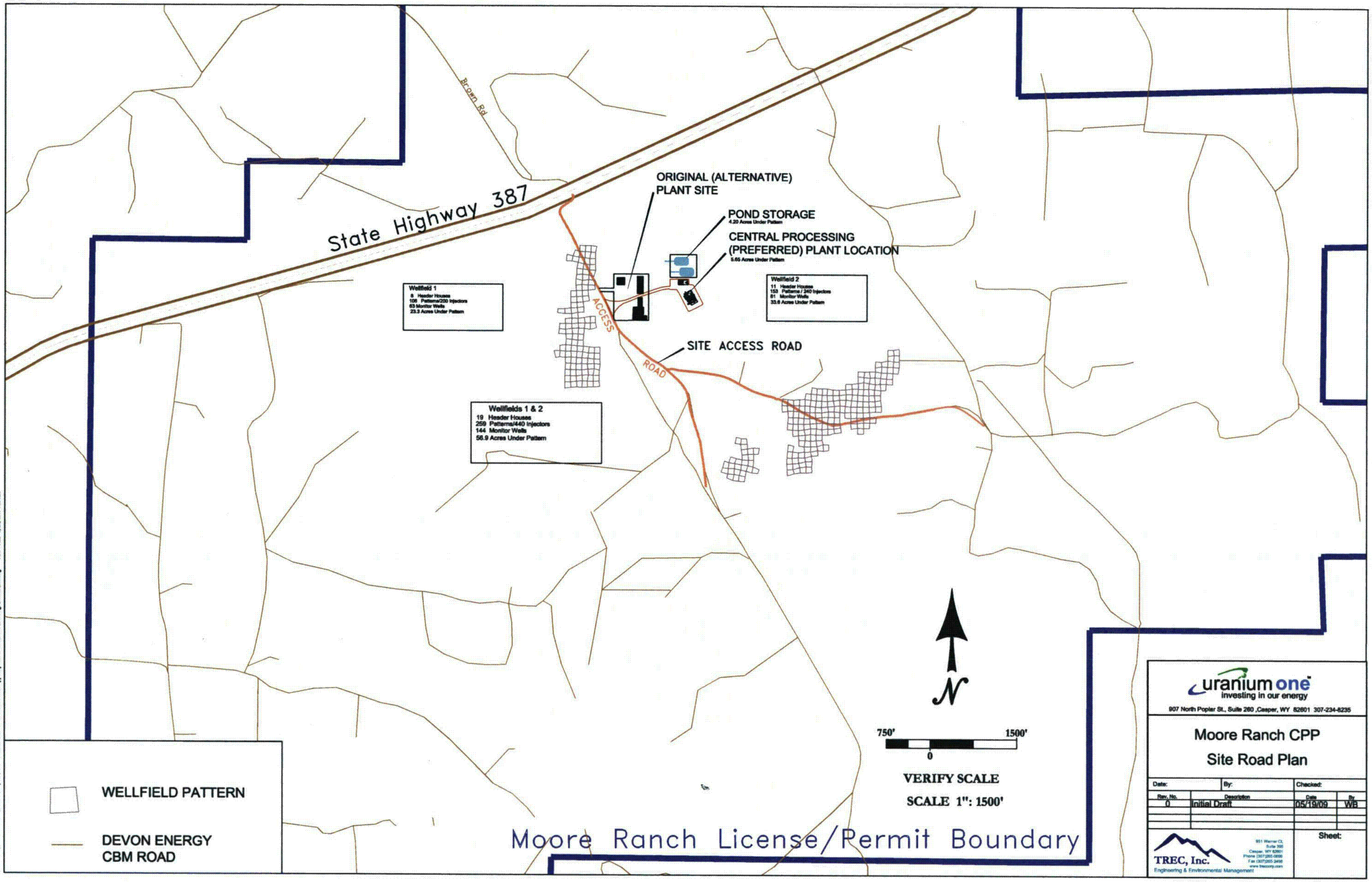
In situ recovery mining of uranium alters the geochemistry and the water quality in the mining zone. Other operating ISR facilities have proven that impacts to groundwater can be controlled through stringent well construction techniques, wellfield operating methodologies that minimize excursions, and the use of best practicable technologies to restore the groundwater after mining activities are complete. The success of the groundwater protection practices proposed by EMC was discussed in Section 6.

The impacts discussed in Section 7 include short-term and long-term impacts. However, it should be noted that in situ recovery mining technique allows the entire mine site to be decommissioned and returned to unrestricted use within a relatively short time so there are no long-term impacts.

8.3 REASONABLE ALTERNATIVES

8.3.1 Plant Location Alternatives

The site of the Moore Ranch Central Plant was initially planned at a location which was situated approximately 700 feet to the west of the current preferred location, shown in Figure 8.3-1. The current proposed plant site was deemed the more suitable location primarily due to existing topography, and the minimal topographic changes that would be required for the proposed layout to the plant infrastructure. The new proposed site location minimizes cut and fill, thereby minimizing the disturbance of natural ground. The revised site location, as with the alternate site location, is located to minimize environmental impacts in that it will be in close proximity to the primary access road, it will avoid existing utilities, and its visibility from Highway 387 will be minimized.


State Highway 387
Brown Rd
ORIGINAL (ALTERNATIVE)
PLANT SITE
POND STORAGE
4.20 Acres Under Pattern
CENTRAL PROCESSING
(PREFERRED) PLANT LOCATION
5.65 Acres Under Pattern
Wellfield 1
8 Header Houses
106 Patterns/200 Injectors
63 Monitor Wells
23.3 Acres Under Pattern
Wellfield 2
11 Header Houses
153 Patterns / 240 Injectors
81 Monitor Wells
33.6 Acres Under Pattern
ACCESS
ROAD
SITE ACCESS ROAD
Wellfields 1 & 2
19 Header Houses
259 Patterns/440 Injectors
144 Monitor Wells
56.9 Acres Under Pattern
N
750'
0
1500'
VERIFY SCALE
SCALE 1": 1500'
WELLFIELD PATTERN
DEVON ENERGY
CBM ROAD
Moore Ranch License/Permit Boundary
uranium one
investing in our energy
907 North Poplar St., Suite 260 ,Casper, WY 82601 307-234-8235
Moore Ranch CPP
Site Road Plan
Date:
By:
Checked:
Rev. No.
Description
Date
By
0
Initial Draft
05/19/09
WB
Sheet:
TREC, Inc.
Engineering & Environmental Management

8.3.2 Process Alternatives

8.3.2.1 Lixiviant Chemistry

EMC proposes to use a sodium bicarbonate lixiviant that is an alkaline solution. Where the groundwater contains carbonate, an alkaline lixiviant will mobilize fewer hazardous elements from the ore body and will require less chemical addition than an acidic lixiviant. Also, test results at other projects indicate only limited success with acidic lixiviants, while the sodium bicarbonate has proven highly successful at commercial mining operations in the Powder River Basin to date. Alternate leach solutions include ammonium carbonate solutions and acidic leach solutions. These solutions have been used in solution mining programs in other locations. However, operators have experienced difficulty in restoring and stabilizing the aquifer. Therefore these solutions were excluded from consideration.

8.3.2.1.1 Acidic Leach Solutions

Acid-based lixiviants, such as sulfuric acid, have been used in the United States and are widely used internationally. Acid leach has historically produced a majority of the world's ISL production. Acid-based lixiviants generally achieve a higher degree of recovery (70 to 90%), better leaching kinetics, and a shorter leaching period. However, acid-based lixiviants dissolve heavy metals and other solids associated with uranium in the host rock and other chemical constituents that required additional remediation (International Atomic Energy Agency, 2001).

In the United States, acid-based lixiviants have been used only for small-scale research and development operations. At the Nine Mile test site in Wyoming, test patterns were developed using acid-based and carbonate-based lixiviants. The acid-based pattern developed two significant problems. During uranium recovery operations, gypsum precipitated on well screens and within the aquifer, plugging wells and reducing the efficiency of wellfield circulation. Restoration efforts had limited success, apparently due to gradual dissolution of the precipitated gypsum following restoration, resulting in increased salinity and sulfate levels in the affected groundwater (Mudd, 2000).

Acid-based lixiviants were not found to be more cost effective than alkaline lixiviants, particularly in light of difficulties in achieving acceptable groundwater restoration results. The commercial use of alkaline lixiviants in the United States has been related to the need to restore affected groundwater and alkaline mine sites are recognized to be technically easier to restore. For this reason, a commercial ISR facility using an acid-based lixiviant has not been developed in the United States and EMC determined an acid-based lixiviant was not a suitable alternative for Moore Ranch.

8.3.2.1.2 Ammonia-based Lixiviants

Ammonia-based lixiviants have been used in the United States, including in Texas and Wyoming. The ammonia tended to adsorb onto clay minerals in the subsurface. The ammonia desorbs slowly from the clay during restoration, and therefore the aquifer requires that a much larger amount of groundwater be removed and processed during aquifer restoration (Mudd, 2000). In addition, concerns arose in the early 1980s over the potential post mining oxidation of ammonia in the groundwater to form nitrate and nitrite species. This potential difficulty in addition to the slow desorbtion of ammonia from clays resulted in a movement away from ammonia based lixiviants and an outright ban on their use in Texas. Due to this additional consumptive use of groundwater to meet groundwater restoration requirements, EMC determined that an ammonia-based lixiviant was not a suitable alternative for Moore Ranch.

8.3.2.1.3 Other Lixiviants

Other lixiviants which have been evaluated in laboratory scale and limited field tests include potassium based lixiviants, a range of oxidants including air, iodine, potassium permanganate, and a variety of trace additives such as clay stabilizing agents to increase the selective oxidation and mobilization of uranium minerals. To date, these alternatives have consistently proven to be far less economical than the planned oxygen – sodium bicarbonate system.

8.3.2.2 Groundwater Restoration

The success of the groundwater restoration techniques proposed by EMC has been shown at other ISR mining operations in the Powder River Basin. Groundwater sweep, permeate/reductant injection and groundwater treatment have successful restored the groundwater to pre-mining quality. No feasible alternative groundwater restoration method is currently available. The NRC and the WDEQ consider the method currently employed as the Best Practicable Technology (BPT) available.

8.3.2.3 Waste Management

Liquid wastes generated from production and restoration activities are generally managed at ISR facilities by solar evaporation ponds, deep well injection, and/or land application. The use of deep waste disposal well(s) is considered by EMC to be the best alternative to dispose of these types of wastes. The Moore Ranch deep well(s) will isolate liquid wastes generated by the project from any underground source of drinking water (USDW). These wells must be authorized by the State of Wyoming under a Class I UIC Permit. EMC has considered a wide range of liquid treatment/disposal methods for use at Moore Ranch. The alternatives analysis considered three primary waste streams from ISR operation:

- Plant eluant;
- Wellfield purge water; and
- RO reject produced during wellfield restoration.

A "design basis influent" was developed for the three typical ISR wastewater streams to be managed as well as the projected water quality characterization for blending the waste streams. The alternatives analysis was completed stepwise with the development of a common evaluation basis, screening of potentially applicable treatment technologies, development of candidate treatment trains, and technical and cost evaluation of the treatment trains. The initial screening of treatment technologies included evaluation of each technology for implementability, flexibility, maintainability, and relative capital and operating costs. The retained technologies were developed into treatment options and then the comparative evaluation of each option was conducted in parallel for each waste stream. Both capital and annual operating costs were developed for each option in order to calculate a net present value. The costs developed were comparative order-of-magnitude estimates intended for comparison purposes and were based on an ISR model case that could then be scaled to a particular operation. Costs that were common to all options such as regulatory reporting, project management, and administrative costs were not included.

Land application is feasible and has been historically used at some ISR facilities as a wastewater treatment/disposal method, generally in conjunction with deep well disposal and/or spray/solar evaporation. However, discharges through land application may be required to meet surface water quality standards. If land-applied water is not treated to stringent standards there is a potential for future environmental liability due to accumulation of contaminants in the soil or groundwater below the land application surface area. For this reason land application was not retained in the screening process for further consideration.

The following discussion provides a description of each treatment/disposal method considered and the relevant characteristics that led to the selection of deep well injection as the preferred alternative.

8.3.2.3.1 Deep well disposal

On any site where geologic and hydrogeologic conditions would allow, deep well injection is the current preferred method for wastewater disposal. Deep well injection is permitted primarily on the condition that potential sources of drinking water cannot be adversely impacted by the deep well operation, rather than by the quality and characteristics of the wastewater injected. Deep well "discharge standards" as incorporated into a permit are based on the mine operator's characterization of the waste stream. This method was considered potentially suitable for all ISR waste streams.

8.3.2.3.2 Mechanical Evaporation

Mechanical evaporation utilizing equipment that requires either gas or electric power was considered. Evaporation is energy-intensive, but produces the smallest possible volume of waste for disposal. Disposal costs per unit volume can be evaluated against the evaporator operations cost to determine the economic viability of evaporation as a post-treatment step. For this evaluation it is assumed that a volume reduction of approximately 95% is achieved. This method was considered potentially suitable for all ISR waste streams.

8.3.2.3.3 Chemical Precipitation and Reverse Osmosis

Chemical precipitation and reverse osmosis which can utilize the chemical precipitation step to either pretreat the wastewater for more efficient operation of the reverse osmosis system or use the chemical precipitation step to treat the brine was considered. Both a brine residual and a sludge are formed. This method was considered potentially suitable for all ISR waste streams.

8.3.2.3.4 Spray/solar evaporation

Spray/solar evaporation utilizing natural evaporation and enhancing the rate by spraying water to increase the surface area, which was assumed to provide a 95% volume reduction for this evaluation, was considered. While solar evaporation is technically feasible, the evaporation rate and length of the evaporation season must be considered in parallel with the flow rate of water to be treated. Pond size may become infeasibly large if the evaporation rate is low. If sprayers are used for evaporation enhancement, overspray due to high winds must be controlled. Additional issues with ponds include dust and dirt blown in, and the eventual need to remove salts and accumulated solids.

Table 8-1 provides a summary of the technical and cost evaluation of candidate water treatment and management options for a combination of the process wastewaters. For each of the alternatives considered, the table lists the advantages and disadvantages, the chemicals required, residues storage capacity, required offsite shipments, power requirements, labor requirements, environmental and safety considerations, capital cost, and 20-yr Net Present Value. For capital cost and 20-yr NPV, the deep disposal well alternative is considered the base case and the capital cost and 20-year NPV for the other alternatives are scaled from it.

As shown by Table 8.3-1, the NPV for the Deep Well Option and the Spray/Solar Evaporation Option were the most favorable (lowest estimated life cycle cost), with the Deep Well Option as the lowest overall cost. The Deep Well option presents additional environmental, safety and health benefits including the following:

- Minimize worker exposure to concentrated brine streams that may contain uranium and byproduct material;

- Minimize the required footprint and therefore land disturbed by the system;

- Minimize the residual, either solid or liquid, stored onsite and also shipped offsite. There is no offsite transportation of residual required with a deep well; and

- Minimize the requirement for chemicals and other commodities.

Based on this comparative evaluation the deep well water management option for ISR wastewater provides clear economic and environmental advantages.

All solid wastes will be properly managed. Non-contaminated solid waste will be disposed in an off site solid waste landfill permitted by the county in which it is located. Contaminated wastes will be shipped to a NRC or Agreement State-licensed facility for disposal.

Table 8.3-1
Treatment Alternatives Comparative Evaluation Matrix – 150 gpm ISL Wastewater

Evaluation Factor	Deep Well	Mechanical Evaporation	Chemical Precipitation/RO	Spray/Solar Evaporation
Advantages	Economical, no residuals so no onsite storage or offsite transport required, no concentrated chemicals required, minimal operating requirements, minimal space requirements, flexible with regard to water quality and disposal rate.	Produces very low volume brine for disposal or further processing by solidification or to dry salt for zero liquid discharge, produces treated water with essentially zero contaminants (distilled water), can be operated campaign style.	Broadly applicable to metals and common anion contaminants, chemical precipitation pretreatment allows operation of RO system to produce less brine, produces high quality treated water stream for reuse or discharge.	Primary treatment is simple system consisting of ponds, pumps, piping and nozzles. No complicated equipment, low capital cost. Commonly used for management of brine in arid climates. Can allow complete evaporation to dryness or remove low volume brine for solidification and offsite disposal.
Disadvantages	Site geology will dictate feasible disposal flow rate. Site hydrogeology (presence of potential drinking water aquifers) will dictate disposal well depth. Permitting process may be lengthy. Attention to water chemistry and need for antiscalent is required to minimize wellscreen scaling and fouling issues. Changes in water chemistry may require re-permitting. No recovery of treated water.	Long equipment lead, distillate is corrosive and would need conditioning for reuse or discharge, high capital and power cost, concentrates radionuclides into the evaporator brine by 20 times or more.	Produces both liquid and solids residues with higher volume liquid residues that other options. Highest labor. Requires bulk concentrated chemicals. Highest truck traffic of options evaluated for chemical deliveries and residuals transport.	Treatment rate dependent upon weather. "Overdesign" required to account for weather shutdowns. Potential for birds and other wildlife to drink and contact water. Treatment time affected by wind with high potential for overspray. Reduced efficiency and operating difficulty due to freezing in winter so large storage capacity required. Windborne dust and dirt reduce efficiency and increase maintenance (cleanouts). Large quantities of chemicals required for solidification and large quantities of solidified brine produced for offsite disposal.

Table 8.3-1
Treatment Alternatives Comparative Evaluation Matrix – 150 gpm ISL Wastewater

Evaluation Factor	Deep Well	Mechanical Evaporation	Chemical Precipitation/RO	Spray/Solar Evaporation
Chemicals Required	None to minimal. Antiscalent may be required depending on water characteristics.	Minimal for evaporator and limited to antiscalent compounds and some cleaning products. Lime, soda ash, and polymer required for solidification.	Lime Concentrated acid Polymer, antiscalent and RO cleaning chemicals. Lime, soda ash and polymer for solidification.	Lime, soda ash, and polymer for solidification.
Residues Storage Capacity	Small feed tank – 10,000 gal storing regular strength wastewater	60,000 gal brine storage – approximately 5 days of storage for feed to solidification system. 100 yd^3 solidified brine (3-4 days)	200,000 gal brine storage – (4 days) 80 yd^3 sludge (20% solids by weight) from chemical precipitation storage 500 yd^3 solidified brine (3-4 days)	40,000,000 gal storage for low evaporation months 60,000 gal brine storage for low evaporation months 100 yd^e solidified brine (3-4 days)
Offsite Shipments	None	Approximately 10 trucks per week with solidified brine.	Approximately 43 trucks per week with solidified brine and dewatered sludge.	Approximately 10 trucks per week with solidified brine.
Other Considerations	None	Brine is concentrated waste (20X feed), potentially characterized as hazardous or mixed waste	Brine is concentrated waste (6X feed) potentially characterized as hazardous or mixed waste	Brine is concentrated waste (20X feed) potentially characterized as hazardous or mixed waste
Power	710,000 kwh/yr	11,008,000 kwh/yr	2,912,000 kwh/yr	8,822,000 kwh/yr
Labor	Minimal	3 – 4 FTE	6 FTE	3 – 4 FTE

Table 8.3-1
Treatment Alternatives Comparative Evaluation Matrix – 150 gpm ISL Wastewater

Evaluation Factor	Deep Well	Mechanical Evaporation	Chemical Precipitation/RO	Spray/Solar Evaporation
Environmental /Safety	Safest and lowest environmental impact of options. Smallest carbon footprint with low operating power requirement and no truck traffic. No residuals stored onsite, no potential for wildlife exposure to holding ponds. No requirement for chemicals. No potential exposure to concentrated residues.	Large carbon footprint with over 10 times the power requirement of a deep well and 20 times the power requirement of the RO/precipitation option. Requires high operating temperatures and pressures. Low to moderate footprint primarily for brine storage tanks. Requires storage of brine as feed to solidification system and offsite transportation of solidified brine stream. High chemical requirements for solidification chemicals. High operating temperature and pressure.	Moderate carbon footprint with the lowest operating power requirement but the most truck traffic of any option evaluated. Handling of highest quantity of residues required including onsite storage and offsite disposal. Higher labor requirements with more potential for exposure to chemicals and residuals during sludge dewatering operations and residuals management.	Moderate carbon footprint with greater the power required of a deep well and some truck traffic for offsite brine disposal. Greatest risk to wildlife due to large volume ponds. Greatest potential for release of salts from overspray. Potential for exposure to labor from the sprays.
Capital cost estimate	Base Case	3.56 times base case	1.79 times base case	4.21 times base case
20 Year NPV	Base Case	17.6 times base case	68.9 times base case	17.9 times base case

8.4 ALTERNATIVES CONSIDERED BUT ELIMINATED

As a part of the alternatives analysis conducted by EMC, several mining alternatives were considered. Due to the significant environmental impacts and cost associated with these alternative mining methods in relation to the Moore Ranch ore body, they were eliminated from further consideration.

8.4.1 Mining Alternatives

Underground and open pit mining represent the two currently available alternatives to solution mining for the uranium deposits in the Moore Ranch project area. In the southern Powder River Basin uranium ore has been mined with open pits in the past. This activity occurred from 1970 to 1984 at the Exxon Highland facility and from the mid-1970s to 1986 at Union Pacific Resources Bear Creek site, both located south of the Moore Ranch site. A limited quantity of ore was also mined with underground mining at the Exxon Highland site, in addition to the open pit method. However, the underground mine was uneconomical and plagued by poor ground conditions. Kerr McGee operated a test underground mine at the Bill Smith (now Smith Ranch) Project in the late 1970's with similar results. Subsequent work by Kerr McGee and its successor, Rio Algom Mining Corp, shifted to ISR methods. Likewise, Exxon recognized the inherent advantages of ISR and was in the process of amending the Highland NRC license for conversion of the project to an ISR operation when Highland was sold to Everest Minerals Corp. in 1983. Subsequently, Everest reconfigured the Highland Project into an ISR operation.

The Moore Ranch project was originally investigated by Conoco in the late 1970's as an open pit mine. Neither of these methods is economically viable for producing the Moore Ranch reserves at this time. The following sections discuss each mining alternative in relation to the Moore Ranch site.

8.4.1.1 Open Pit Mining

Open pit mining requires the removal of all material covering the orebody. This overburden must be removed and stockpiled to allow removal of the uranium-bearing ore. Once removed, the ore must be transported to a conventional uranium mill for further processing and uranium extraction.

Open pit mining of the relatively low grade Moore Ranch ore would require a capital investment that is not supported by the current uranium market. The nearest conventional mill with an operating license that could receive uranium ore for toll milling is the Denison Mines White Mesa Mill located in Blanding, Utah. The combination of capital costs to develop an open pit mine at Moore Ranch, the operating and maintenance costs to mine the ore, and the transportation costs to Blanding, Utah far exceed the current value of the ore as a feedstock for White Mesa. The nearest conventional uranium mill, Kennecott Uranium Corporation's Sweetwater Mill, located in the Great Divide Basin in Wyoming, is not licensed for operations. However, if the Sweetwater Uranium Mill was currently licensed for operation, similar economic factors would preclude mining the Moore Ranch deposit under current uranium market conditions.

Environmental factors must also be considered in addition to the economic factors for open pit mining. Open pit mining would produce large piles of waste rock that would permanently alter the topography of the Moore Ranch site. In addition, substantial dewatering of the pit on the order of several thousand gallons per minute would be required to depress the potentiometric surface. Large quantities of groundwater with naturally elevated radium-226 and uranium would be discharged requiring treatment and subsequent disposal of a radioactive solid waste.

8.4.1.2 Underground Mining

Underground mining of the Moore Ranch deposit would involve sinking mine shafts to the vicinity of the orebodies, horizontally driving crosscuts and drifts to the orebodies at different levels, physically removing the ore and transporting the mined ore to the conventional uranium mill for further processing. The economic factors involved with this alternative are identical to those for ores mined from an open pit.

From an environmental perspective, open pit mining or underground mining and the associated milling process involve higher risks to employees, the public, and the environment. Radiological exposure to the personnel in these processes is increased not only from the mining process but also from milling and the resultant mill tailings. The milling process generates a significant amount of waste relative to the amount of ore processed. Extensive mill tailings ponds are needed for the disposal of these wastes. The environmental impacts associated with open pit and underground mining are generally recognized as being considerably greater than those associated with in-situ recovery mining.

In a comparison of the overall impacts of ISR mining of uranium compared with conventional mining, an NRC evaluation[3] concluded that environmental and socioeconomic advantages of in situ recovery include the following:

1. Significantly less surface area is disturbed than in surface mining, and the degree of disruption is much less. In addition, this disturbance is temporary in nature, being limited to the period of construction, operations, and decommissioning.

2. No mill tailings are produced and the volume of solid wastes is reduced significantly. The gross quantity of solid wastes produced by ISR methods is generally less than 1% of that produced by conventional milling methods (more than 948 kg (2090 lb) of tailings usually result from processing each metric ton (2200 lb) of ore).

3. Because no ore and overburden stockpiles or tailings pile(s) are created and the crushing and grinding ore-processing operations are not needed, the air exposure problems caused by windblown dusts from these sources, both on site and during transportation, are eliminated.

4. The tailings produced by conventional mills contain essentially all of the uranium daughter products including radium-226 that are originally present in the ore. By comparison, less than 5% of the radium in an ore body is brought to the surface when ISR methods are used. Consequently, operating personnel are not exposed to the radionuclides present in and emanating from the ore and tailings and the potential for radiation exposure is significantly less than that associated with conventional mining and milling.

5. By removing the solid wastes from the site to a licensed waste disposal site and otherwise restricting them from contaminating the surface and subsurface environment, the entire mine site can be returned to unrestricted use within a relatively short time.

6. Solution mining results in significantly less water consumption than conventional mining and milling.

7. The socioeconomic advantages of ISR include:

    - The ability to mine a lower grade ore,
    - A lower capital investment,
    - Less risk to the miner,
    - Shorter lead time before production begins, and
    - Lower manpower requirements.

8.5 CUMULATIVE EFFECTS

8.5.1 Future Development

EMC has other potential resource areas identified in the Powder River Basin that may be developed as satellite facilities to the Moore Ranch Central Plant. Development of these facilities is dependent upon further site investigations by EMC and the future of the uranium market. If conditions warrant, EMC may submit license amendment requests to permit development of these additional resources. EMC currently projects that development of these areas would be primarily intended to maintain production allowed under the proposed license as reserves in the Moore Ranch site deplete.

8.6 COMPARISON OF THE PREDICTED ENVIRONMENTAL IMPACTS

Table 8.6-1 provides a summary of the environmental impacts for the no-action alternative (Section 8.1), the preferred alternative (Section 8.2), and the process alternatives (Section 8.3). The predicted impacts for the mining alternatives discussed in Section 8.4 are not included for comparison because these alternatives were rejected due to significant environmental and economic impacts. Environmental impacts were discussed in greater detail in Section 7.

Table 8.6-1: Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	Alternate Waste Management
Land Surface Impacts	None	Minimal temporary impacts in wellfield areas; Wellfield 1 = approximately 23 acres under pattern; Wellfield 2 = approximately 34 acres under pattern; Significant surface and subsurface disturbance confined to a portion of the Central Plant site = approximately 6 acres	Same as Preferred Alternative.	Same as Preferred Alternative. Potential additional impacts from land application of treated waste water and construction of evaporation pond alternatives.
Land Use Impacts	None	Loss of agricultural production (livestock grazing) in the impacted area (estimated 63 acres) for duration of project.	Same as Preferred Alternative.	Same as Preferred Alternative plus additional land use impact from installation of evaporation ponds and/or land application areas.
Transportation Impacts	None	Minimal impact on current traffic levels.	Same as Preferred Alternative.	Additional transportation impacts for mechanical or solar evaporation (10 trucks per week) and chemical precipitation/RO (43 trucks per week).
Geology and Soil Impacts	None	No geologic impacts. Minimal temporary soil impacts in disturbance areas (estimated 63 acres) from wind and water erosion.	Same as Preferred Alternative.	Same as Preferred Alternative. Potential additional impacts to soils from land application of treated waste water.

Table 8.6-1: Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	Alternate Waste Management
Surface Water Impacts	None	None	None	None
Groundwater Impacts	None	Consumption of mining zone groundwater at an average rate of 105 GPM for control of mining solutions and restoration	Same as Preferred Alternative. Increased difficulty with groundwater restoration and stabilization resulting in increased water consumption for ammonia based lixiviants..	Same as Preferred Alternative.
Ecological Impacts	None	No substantive impairment of ecological stability or diminishing of biological diversity.	Same as Preferred Alternative.	Same as Preferred Alternative.
Air Quality Impacts	None	Additional total dust emissions of 15.5 tons per year due to vehicle traffic on gravel roads.	Same as Preferred Alternative.	Same as Preferred Alternative.

Table 8.6-1: Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	Alternate Waste Management
Noise Impacts	None	Barely perceptible increase over background noise levels in the area. Common equipment noise levels during the construction phase range from 70 to 101 dB at 50 feet distance. Using a 100 dB sound level at the Central Plant and a drop ratio of 6 dB per doubled distance, a maximum noise level of 80 dB at 4500 feet distance from the Central Plant. (See Technical Report Section 7.1.5).	Same as Preferred Alternative.	Same as Preferred Alternative.
Historic and Cultural Impacts	None	None	None	None
Visual/Scenic Impacts	None	Moderate impact; noticeable minor industrial component.	Same as Preferred Alternative.	Same as Preferred Alternative plus additional visual and scenic impacts from installation of evaporation ponds and/or land application areas.
Socioeconomic Impacts	Loss of positive economic impact of $28.8M and 601 temporary and permanent jobs to Campbell County and the surrounding area	Annual direct economic impact of $28.8M and 601 temporary and permanent jobs to local area	Same as Preferred Alternative.	Same as Preferred Alternative.

Table 8.6-1: Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	Alternate Waste Management
Nonradiological Health Impacts	None	None	None	None
Radiological Health Impacts	None	Estimated maximum dose from radon gas released at Moore Ranch at the project boundary is 1.5 mrem/yr or 1.5% of the public dose limit.	Same as Preferred Alternative.	Additional occupational exposure for handling concentrated brine byproduct material for disposal.
Waste Management Impacts	None	Generation of additional liquid and solid waste for proper disposal. The maximum volume of liquid water stream for well disposal will be approximately 45 gpm during normal operations and approximately 100 gpm during restoration. The septic systems include an approximately 1000 gallon shop septic tank, and a 2000 gallon plant septic tank; uncontaminated solid waste generated will be approximately 2,000 cubic yards per year.	Same as Preferred Alternative. Mobilization of additional hazardous elements in lixiviant requiring disposal.	Generation of additional 11e.(2) byproduct material from mechanical evaporation, chemical precipitation/RO, and decommissioning evaporation ponds as shown in Table 8.3-1

Table 8.6-1: Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	Alternate Waste Management
Mineral Resource Recovery Impacts	Loss of a valuable domestic energy resource. EMC estimated reserves are under development but the current estimated recoverable resource is 5.8 million pounds with a current spot market value of $522 million (based on $90/lb).	Recovery and use of a domestic energy resource.	Same as Preferred Alternative.	Same as Preferred Alternative.

REFERENCES

[1] Energy Information Administration, *Summary Production Statistics of the U.S. Uranium Industry*, www.eia.doe.gov/cneaf/nuclear/dupr/usummary.html accessed August 14, 2007.

[2] Energy Information Administration, *2006 Uranium Market Annual Report*, www.eia.doe.gov/cneaf/nuclear/umar/umar.html, accessed August 14, 2007.

[3] U.S. Nuclear Regulatory Commission, *Draft Environmental Statement Related to the Operation of the Teton Project*, NUREG-0925, June 1982. Para. 2.3.5.

9 BENEFIT-COST ANALYSIS

9.1 BENEFIT-COST ANALYSIS GENERAL BACKGROUND

Benefit-cost analysis (BCA) has established that the proposed development of a new uranium in-situ recovery facility at the Moore Ranch Project is potentially a cost-effective project to undertake and will provide a net economic benefit to the State of Wyoming.

This analysis has been specifically tailored to meet the requirements established by the Nuclear Regulatory Commission (NRC) NUREG 1569, and includes a description of the economic benefits from the construction and operation of the proposed Moore Ranch Project and a discussion of the temporary and long-term external costs. Where possible, benefit and cost estimates are monetized; however, reliable monetary estimates for some potential impacts are not readily available so the narrative examines several factors in non-monetary or qualitative terms.

The following analyses use IMPLAN (IMpact Analysis for PLANning), a standard industry software package that models the economic impacts of capital intensive projects, to calculate the potential economic impacts to the county. It was originally developed by the United States Department of Agriculture (USDA) Forest Service in cooperation with the Federal Emergency Management Agency (FEMA) and the United States Department of the Interior (USDI) Bureau of Land Management (BLM) for land and resource management planning (IMPLAN 2004). Currently, it is being managed by the Minnesota IMPLAN Group, Inc. (MIG).

9.2 ALTERNATIVES AND ASSUMPTIONS

BCA is widely used analytical tool for helping decision makers determine whether the cost of a project today will result in sufficient benefits to justify expenditure on a capital intensive project (Brown 2003; Zerbe and Bellas 2006). To provide value and to assist in the decision process, the BCA needs to be clear about the alternatives being considered and the underlying assumptions including quantities of goods, labor costs, market conditions and discount rates used to compute net present value. The following discussion briefly identifies alternatives and key assumptions used throughout the analysis.

9.2.1 Development Alternatives

This BCA evaluates the benefits and costs of building the Moore Ranch Project and all the costs and benefits resulting from its ongoing operation in Campbell County, Wyoming. The BCA tradeoff under consideration involves comparing a future with the proposed Moore Ranch Project to a future that represents a continuance of the no action.

9.2.1.1 No Action Alternative

Under the no action alternative, there would be no change in the current land cover or land and water uses at the site; therefore, there would be no change in the existing underlying socioeconomic and demographic trends.

9.2.1.2 Proposed Action

The proposed action involves the construction and operation of a uranium in-situ recovery (ISR) facility. ISR involves leaving the ore where it is in the ground and using liquids which are pumped through it to recover the minerals out of the ore. Consequently, the proposed action involves limited surface disturbance at the Moore Ranch Project and no tailings or waste rock would be generated.

9.2.2 Key Assumptions and Limitations

Key assumptions about the costs and benefits associated with the proposed Moore Ranch Project involve: (1) The Operating Life of the project; (2) the Discount Rate used; (3) the Scope of the Impact; and (4) Non-monetary Impacts. Each of these is described in more detail below.

9.2.2.1 Operating Life of Moore Ranch Project

The Moore Ranch Project will be a single unit of analysis including the wellfields, central plant, and outlying related structures. For this analysis, the total effective life of the Project is assumed to be 27 years. Within this time frame, there are three distinct phases of operation with a distinct suite of costs and benefits:

- 2 years of site development and facility construction (1 year for initial construction and 1 year for construction related to plant expansion during operations some time in the future)

- 10 years of wellfields and central plant operation
- 15 years of the central plant continuing operation after decommissioning the wellfields.

9.2.2.2 Discount Rate

Computing the net present value (NPV) of the proposed Moore Ranch Project requires that future benefits and costs be discounted. This discounting reflects the time value of money that benefits and costs are worth more if they are expected sooner. Following guidelines established by circular A-94 from the United States Office of Management and Budget (OMB), net present value estimates of benefits and costs are reported using a real discount rate of 7 percent (OMB 1992). Circular A-94 was revised in 1992 based on extensive review and public comment and currently reflects the best available guidance on standardized measures of costs and benefits. This rate approximates the marginal pretax rate of return on an average investment in the private sector in recent years.

9.2.2.3 Scope of Impact

A critical step in any BCA is establishing a viable scope of impact and thus establishing who will be affected by the Moore Ranch Project (Zerbe and Bellas 2006). As a practical matter the proposed project would be limited to the potential impact it may have on Campbell County.

9.2.2.4 Non-monetary Impacts and Benefit-Cost Ratio

Conventional BCA uses monetary values to compare goods and services derived from a project or program. The values of goods and services represent their relative importance so that if the total value of the benefits is greater than the total value of the costs, the Moor Ranch Project is desirable. The standard result is a quantified benefit-cost ratio (BCR), equal to a project's total net benefits divided by its total cost. BCR's above one have positive net economic impacts. While many inputs in the Moore Ranch Project BCR are goods and services (skilled labor, construction material) that are regularly traded in markets at well known and predictable prices, others (changes to land or water, aesthetic impacts) are not directly traded and are more difficult to value. Where reliable monetary values are not available a qualitative approach based on the best available information is required.

9.3 ECONOMIC BENEFITS OF PROJECT CONSTRUCTION AND OPERATION

This section considers the potential economic impacts resulting from construction and operation-related activities over the life of the Moore Ranch Project. Economic benefits are those that have the potential to affect the local economy, including the number of jobs created and state and local tax revenues generated from project related business activities.

These analyses use IMPLAN to calculate the potential economic impacts to Campbell County. IMPLAN allows the user to build an input-output model tailored to model the potential impact of a proposed project on a specific community or region. The system is flexible and contains a database of over 500 industrial sectors gathered from counties throughout the United States. By identifying the location and industrial sector of the project (i.e., construction and mining), the analyst can therefore estimate the total potential economic impact of a given project. The model requires labor and capital expenditures data as inputs in order to evaluate the potential economic impacts of the project. The output is the potential direct and indirect employment impacts and generated tax revenue.

This analysis focuses on Campbell County, Wyoming and two economic sectors most closely associated with the distinct phases of the proposed Moore Ranch Project: new construction (IMPLAN code 41) and support activities for mining (IMPLAN code 29). Unfortunately, IMPLAN does not currently have a uranium mining sector for Campbell County, so all tax revenue estimates drawn from IMPLAN should be treated as lower-bound estimates given that ad valorem and severance taxes will likely differ for different mining sectors.

9.3.1 INPLAN Input Data

This analysis assumes that the Moore Ranch Project begins in 2009 for initial construction and construction activities take place through late 2009. The second year of construction will occur at a later time during operations for plant expansion and is not included in this analysis. The total estimated number of construction workers employed directly by the applicant is 50 per year, of which 25 (50 percent) would likely be from Campbell County. Construction capital expenditures are estimated at $50 million (including initial construction and future plant expansion), or $25 million per year for the duration of the initial construction period (Table 9.3-1).

Following one year of facility construction, the wellfields and central plant would be fully-operational, employing 60 full-time workers per year for the first 10 years. After completion of mining and restoration activities, 40 full-time workers will be required for continuing plant operations, accepting loaded ion exchange resin from satellite facilities for processing. Approximately 30 (50 percent) of workers would be located in Campbell County. The Moore Ranch Project has the potential to incur up to $12 million in non-payroll-related operating costs annually for the first 10 years, and $1.8 million thereafter.

Table 9.3-1 Input Data for the Moore Ranch Project

Activities	IMPLAN Code	Per Year 2008 - 2009	2010 - 2019	2020 - 2034
Construction Expenditures				
Non-payroll[1]	41	$25 M	NA	NA
Payroll[2]	41	25 workers	NA	NA
Operations Expenditures				
Non-payroll	29	NA	$12 M	$1.8 M
Payroll	29	NA	30 workers	20 workers

[1] Does not include land purchase cost
[2] Limited to Campbell County

9.3.2 Employment Benefits

Using the above assumptions, Table 9.3-2 summarizes the potential employment-related effects generated by the Moore Ranch Project. IMPLAN defines employment as total wage and salary employees, including self-employed jobs that are related to the proposed project. It also includes both full-time and part-time workers and is measured in annual average jobs.

Table 9.3-2 also shows the potential direct, indirect and induced effects on county-wide employment. The direct employment effects refer to the employment directly generated by the Moore Ranch Project. For the initial construction phase in years 2008 to 2009, the model estimated 285 additional non-payroll workers hired in Campbell County per year based on the 25 payroll workers engaged directly in construction activities, and the $25 million of non-wage capital expenditures incurred by the Moore Ranch Project per year.

Potential indirect effects pertain to the inter-industry effects from the direct effects and could include increased labor demand, goods and services required to support the Moore Ranch Project (such as restaurant and hotel staff). In addition, new workers living within Campbell County would spend their income locally which induces additional income and employment. Construction workers living in the county for the construction period would purchase local goods and services which help generate additional employment. The sum of potential direct, indirect and induced effects represents the total potential employment impacts of the Moore Ranch Project.

These results indicate that the Moore Ranch Project is expected to create 401 additional jobs per year for the first year of intensive construction, 147 additional jobs per year in the next 10 years during full operation, and 53 additional jobs per year in the last 15 years of operation. It is important to note that the total potential economic impacts from the Moore Ranch Project could extend to the surrounding areas of Converse, Natrona and Johnson counties. As a result, the total potential employment impacts predicted by this analysis are conservative.

Table 9.3-2 Employment Effects of the Moore Ranch Project in Campbell County

Years	Employment per Year			
	Direct	Indirect	Induced	Total
2008 - 2009	285	59	57	401
2010 - 2019	75	38	34	147
2020 - 2034	27	14	12	53

9.3.3 State and Local Tax Revenue Benefits

In addition to aggregate employment effects, IMPLAN provides an estimate of expected state and local tax revenue impacts over the life of the Moore Ranch Project associated with mining activities. In order to remain consistent with the scope of impact, Federal taxes are not included in this analysis. The results standardized to 2007 dollar equivalents using the OMB recommended real discount rate of 7 percent are presented in Table 9.3-3.

Potential state and local tax implications associated with the proposed Project are presented in Table 9.3-3. While IMPLAN includes employee and employer social insurance taxes as well as personal tax items like income tax, property tax and motor vehicle license tax, these tax revenues are not reported here because they are paid by county workers and their families and thus represent a transfer of wealth rather than a net economic gain. Conversely, corporate dividend taxes and the indirect business tax category associated with the proposed Project consist of tax items such as property tax, sales tax and a state-levied severance tax on uranium production. These revenues stem directly from the construction and operation of the Moore Ranch Project, are paid by the operator of the proposed Moore Ranch Project, and therefore can be counted as net economic gains when compared to the no action alternative.

As table 9.3-3 shows, the results from the IMPLAN analysis show that the construction and operation of the Moore Ranch Project is expected to generate a net present value of approximately $8.0 million in total enterprise and business tax revenues over the life of the Moore Ranch Project.

Table 9.3-3 State and Local Tax Revenue IMPLAN Projections

	Net Present Value ($ Millions) *		
Activities	**Enterprise (Corporate) Tax**	**Indirect Business Tax**	**Total Taxes**
Construction	0.2	1.2	1.4
Operations	1.3	5.3	6.6
Total	1.5	6.5	**8.0**

*2007 DOLLAR EQUIVALENTS

Additionally, severance taxes associated with uranium mining in Campbell County are levied by the State of Wyoming, Mineral Tax Division of the Department of Revenue. The current uranium severance tax is 4% of taxable market value coming from mining operations (Wyoming Department of Revenue—Mineral Tax Division 2007). Current resource estimates for the proposed project are 5.8 million lbs (43-101 compliant). This does not include reserve estimates as these projections are not yet complete. Assuming that the identified 5.8 million lbs were sold at current market prices of approximately $90 per pound, the severance tax would yield approximately $20,800,000 in net economic benefits over the life of the operation.

In sum, the results show that $28.8 million net quantifiable economic benefits can be linked to the proposed project. It is noted that this figure represents a lower bound estimate as it excludes potential reserve resources and does not include potential benefits derived from taxes on royalties or lease payments to local landowners stemming from the operation of the proposed Moore Ranch Project.

9.4 EXTERNAL COSTS OF PROJECT CONSTRUCTION AND OPERATION

In this section of the analysis, external costs of the proposed Moore Ranch Project are identified and compared to the no action alternative. Both short-term and long-term external costs that may affect the interest of people other than the owners and operators of the proposed Moore Ranch Project are also identified and described.

9.4.1 Short Term External Costs

9.4.1.1 Housing Shortages

Approximately 50 percent of the total construction and operating work force for the proposed Moore Ranch Project would likely come from Campbell County. The remaining workforce would likely be based in Casper, located in neighboring Natrona County. The IMPLAN model results show that in 2008-2009, the Moore Ranch Project is expected to generate 401 new jobs due to construction-related activities. In 2010, 147 new jobs are generated for operations-related activities, which are expected to continue until 2019. In 2020, 53 jobs would be needed for central plant operations.

Since the Moore Ranch Project lies within commuting distance of Natrona County, no impacts on the housing situation in nearby cities or towns are anticipated. In the event that workers from out-of-state are hired for the short-term construction phase of the Moore Ranch Project, the present available stock of motel/hotel rooms would accommodate the temporary workers.

In the event that the entire direct payroll and non-payroll workforce relocated to Campbell County, the population increase would be a maximum of 718 for the first phase, 189 for the second phase and 68 for the final phase of operation, based on the 2005 average household size of 2.52 in Wyoming. This increase would account for 2.5 percent of the population of Campbell County as of 2006, thereby posing little or no change from the no action alternative on housing needs in the area.

9.4.1.2 Impacts on Schools and Other Public Services

Two schools are located in Campbell County approximately 22 miles northeast of the Moore Ranch Project area: Cottonwood Elementary School and Cottonwood High School. The total enrollment in the elementary school increased by only 13 percent from 2002 to 2006. The total enrollment for the high school decreased by 15 percent over the same period. The elementary school currently has a student-to-teacher ratio of 12.5 to 1, while the high school has a ratio of 9.7 to 1. In the neighboring Natrona County, the Midwest School provides classes for students from preschool through grade 12. It has a student to teacher ratio of 9.4 to 1.

Families moving into the Campbell County School District as a result of the proposed Moore Ranch Project are not expected to significantly stress the current school system because it is presently under-capacity. Likewise, there is no significant change anticipated from the no action alternative in the demand for other public services such as fire, police, water and utilities. The maximum population increase resulting from the permanent migration of workers into Campbell County represents only 2.5 percent of the population.

9.4.1.3 Impacts on Noise and Congestion

There are no occupied housing units in the vicinity of the proposed Project. Open rangeland is the primary land use within and in the surrounding 2.0-mile area. Other land uses include oil and gas production facilities, as well as pastureland located to the west of the Project area. As a result of the remote location of the Project and the low population density of the surrounding area, impact to noise or congestion within the Project area or in the surrounding 2.0-mile area are not anticipated. Additionally, given the maximum increase in population due to migrant workers is insignificant, noise and congestion impacts are not anticipated in Campbell or other neighboring counties.

9.4.2 Long Term External Costs

9.4.2.1 Impairment of Recreational and Aesthetic Values

While opportunities for developed and dispersed recreation exist throughout the five-county region surrounding the Moore Ranch Project, there are currently no recreational uses within the Moore Ranch Project area or in the surrounding 2.0-mile area, and no developed recreation opportunities are provided on federal and state lands within a 50 mile radius of the proposed Moore Ranch Project. Most developed recreation opportunities offered by the private sector are community facilities in townships or urban areas for tourist services and facilities.

The physical remoteness of the proposed Moore Ranch Project and its lack of proximity to any well recognized federal or state sites of recreational interest indicated that there are no significant long-term impairments to recreational values from developing the Moore Ranch Project.

9.4.2.2 Land Disturbance

The Moore Ranch Project area has been used historically for grazing, prospecting and oil and gas development; therefore, it is unlikely that any undisturbed land area currently exists within the proposed Moore Ranch Project area. A significant, pre-existing human footprint on the landscape is evident in existing grazing activities and facilities (stock tanks, fences), oil production facilities, natural gas production facilities, and infrastructures that support these activities. Oil and gas field infrastructure within the Moore Ranch Project area and the surrounding 2.0-mile review area includes access roads, overhead electric distribution lines, and cleared rights-of-way for underground utilities, which are generally found along access roads. There would be negligible changes in land cover or land use from existing conditions outside of the 2.0-mile review area.

As the proposed Project would use in-situ recovery instead of conventional surface mining techniques, there would be limited land surface disturbance associated with the wellfield development and operation of the site. Land surface disturbance associated with wellfield development would also be short term as interim stabilization with native vegetation species is implemented as soon as construction activities are complete and maintained through the life of the wellfield. No tailings or waste rock would be generated. The Central Plant and private access roads would be confined to clearly delineated areas within the Moore Ranch Project area. While there would be some land use changes from the existing condition within the Moore Ranch Project area, potential impacts will be minimal.

9.4.2.3 Habitat Disturbance

Currently, there is no federally or state designated wildlife habitat located within the proposed Moore Ranch Project area. As the Moore Ranch Project area has been historically used extensively for livestock grazing and oil and gas development, there are no anticipated long-term losses to wildlife or wildlife habitat relative to the existing conditions resulting from the construction and operation of the proposed Moore Ranch Project.

9.4.3 Groundwater Impacts

It is unlikely that any future irrigation development would occur within the proposed Moore Ranch Project area due to limited water supplies, topography, and climate. Irrigation within the 2.0-mile review area is anticipated to be consistent with the past. Based on population projections, future water use within the 2.0-mile review area would likely be a continuation of present use; therefore, it is anticipated that there would be no significant changes from the existing conditions for public water supply in the area.

Following standard mining practice, any impacted water drawn from the aquifer on site would either be treated before re-injection or disposed through deep well injection. Upon decommissioning, wells would be sealed and remaining groundwater would be restored as discussed in Section 6.

Given the historically limited irrigation, the lack of domestic groundwater use, and the groundwater restoration program associated with the proposed Moore Ranch Project, there would be no permanent commitment of water resources required and any potential long-term changes from the no action groundwater conditions would be limited to those identified and addressed in the groundwater restoration program.

9.4.4 Radiological Impacts

As the proposed Moore Ranch Project would be using in-situ recovery techniques, most of the identified radioactivity in the orebody would remain permanently underground. Following standard ISR procedures, routine operational monitoring of air, dust and surface contamination would be undertaken by EMC as discussed in Section 5. Prior to central plant decommissioning, a preliminary radiological survey would be conducted to identify any potential radiological hazards. The survey will also support the development of procedures for dealing with such hazards prior to commencement of decommissioning activities.

Decommissioning of process facilities would be scheduled only after agency approval. This would be accomplished in accordance with an approved decommissioning plan and the most current applicable USNRC rules and regulations, permit and license stipulations and amendments in effect at the time of the decommissioning activity.

All process or potentially contaminated equipment and materials at the process facility including tanks, filters, pumps, piping, etc., would be designated for one of the following removal alternatives:

- Removal to a new location within the Moore Ranch Project area for further use or storage;
- Removal to another licensed facility for either use or permanent disposal; or
- Decontamination to meet unrestricted use criteria for release, sale or other non-restricted use by the landowners and others.

It is likely that process buildings would be dismantled and moved to another location or to a permanent licensed disposal facility. Cement foundation pads and footings would be broken up and trucked to a local disposal site or to a licensed facility if contaminated. The landowners may request that a building or other structures be left on site for future use. In that case, the building would be decontaminated to meet unrestricted use criteria. At the present time, burial of non-contaminated wastes on site is not anticipated.

Under the proposed operating and decommissioning conditions, the potential long-term external radiological impacts at the Moore Ranch Project are anticipated to be negligible compared to the existing background no action conditions.

9.5 BENEFIT-COST SUMMARY

A primary economic benefit of the Moore Ranch Project is the creation of 601 new job opportunities within the county, including the direct, indirect and induced employment effects over the construction and operating life of the Moore Ranch Project (Table 9.5-1). Additionally, the Moore Ranch Project may generate up to $28.8 million in total state and local business tax revenues over the life of the Moore Ranch Project, which is a significant economic gain compared to the no action alternative.

Table 9.5-1 further shows that the short-terms effects on housing, schools and public facilities and the increased potential for noise and congestion in the county involve little or no change compared to the current conditions. Based on the historical land uses, physical remoteness and proposed reclamation practices, no potential quantifiable long-term impairments appear to significantly offset the benefits of the proposed Moore Ranch Project.

The proposed Moore Ranch Project is likely to place negligible short-term or long-term cost burdens on the county, while providing increased revenue and employment opportunities; therefore, the development and operation of the proposed Moore Ranch Project would provide a net economic benefit to Campbell County when compared to the no action alternative.

Table 9.5-1 Summary of Benefits and Costs for the Moore Ranch Project

Benefits	Costs
• **Tax revenue** $28.8 million • **Temporary and permanent jobs** 601 jobs	• **Housing impacts** Little or no change • **Schools and Public Facilities** Negligible • **Noise and Congestion** None • **Impairment of recreational and Aesthetic values** Negligible • **Land Disturbance** Minor • **Groundwater impacts** Controlled through mitigation • **Radiological Impacts** Controlled through mitigation

9.6 REFERENCES

Campbell, H. and R. Brown. 2003. Benefit-Cost Analysis: Financial and Economic Appraisal Using Spreadsheets. New York: Cambridge University Press.

IMPLAN 2004. IMPLAN Professional Version 2.0 Manual Third Edition. Minnesota IMPLAN Group, Inc. February.

U.S. Office of Management and Budget (OMB). 1992. Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.

Wyoming Department of Revenue—Mineral Tax Division 2007. Severance Tax Report for Uranium Form 5200.

Zerbe, R. O. and A.S. Bellas. 2006. A Primer for Benefit-Cost Analysis. Northampton, MA: Edward Elgar.

10.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

Various permits and approvals from numerous Federal and State agencies will be required for the Moore Ranch Project to operate. Section 10.1 identifies the issuing agencies, a description of the type of permit(s), license or approvals needed, and the current status of securing these approvals.

10.1 APPLICABLE REGULATORY REQUIREMENTS, PERMITS, AND REQUIRED CONSULTATIONS

As stated above, Table 10.1-1 lists the necessary environmental approvals from Federal and State Agencies required for the Moore Ranch Project. All remaining approvals are in-progress. All necessary approvals must be secured prior to commencement of commercial production at the site.

Table 10.1-1: Environmental Approvals for the Moore Ranch Uranium Project

Issuing Agency	Description	Status
Wyoming Department of Environmental Quality 122 West 25th St Herschler Building Cheyenne, Wyoming 82001	Underground Injection Control Class III Permit (WDEQ Title 35-11)	Class III UIC Permit application under review; expected approval by WDEQ in June 2010
	Aquifer Exemption (WDEQ Title 35-11)	Aquifer exemption application under preparation; approval by WDEQ expected in June 2010
	Underground Injection Control Class I (WDEQ Title 35-11)	Class I UIC Permit application under review; expected approval by WDEQ in first quarter 2010
	Industrial Stormwater NPDES Permit (WDEQ Title 35-11)	An Industrial Stormwater NPDES will be required for the Central Plant Area. Expected submittal second quarter 2011
	Construction Stormwater NPDES Permit (WDEQ Title 35-11)	Construction Stormwater NPDES authorizations are applied for and issued annually under a general permit based on projected construction activities. The Notice of Intent will be filed at least 30 days before construction activities begin in accordance with WDEQ requirements.
	Mineral Exploration Permit (WDEQ Title 35-11)	Mineral Exploration Permit 342DN Approved: August 22, 2006

Table 10.1-1: Environmental Approvals for the Moore Ranch Uranium Project

Issuing Agency	Description	Status
	Underground Injection Control Class V (WDEQ Title 35-11)	The Class V UIC permit will be applied for following installation of an approved site septic system during facility construction.
	Air Quality Permit	Application submitted first quarter 2010 and under agency technical review
U.S. Nuclear Regulatory Commission Washington, DC 20555	Materials License (10 CFR 40)	Application Submitted herein
U.S. Environmental Protection Agency 1200 Pennsylvania Ave, NW, Washington, DC 20460	Aquifer Exemption (40 CFR 144, 146)	Aquifer exemption application forwarded to EPA following WDEQ action

10.2 ENVIRONMENTAL CONSULTATION

During the course of the preparation of this license application, consultations were conducted with several agencies:

Ecological Resources

Preparation of the ecological resources discussion (Sections 2.0) required consultations with the following individuals and agencies:

- Wetlands — Mike Burgan US Army Corps of Engineers
  2232 Del Range Blvd. Suite 210
  Cheyenne, WY 82009
- Soils — Jon Sweet – Soils Scientist – WDEQ-LQD, District III
  1866 South Sheridan Ave.
  Sheridan, WY 82801
- Vegetation — Stacy Page – WDEQ-LQD, District III
  1866 South Sheridan Ave.
  Sheridan, WY 82801

- Wildlife — Vern Stetler - Coordinator
  Statewide Habitat Protection
  Wyoming Game and Fish Department
  5400 Bishop Rd.
  Cheyenne, WY 82006

  Scott Covington - Terrestrial Biologist
  Wyoming Game and Fish Department
  5400 Bishop Rd.
  Cheyenne, WY 82006

  Brian Kelly
  US Fish and Wildlife Service
  4000 Airport Parkway
  Cheyenne, WY 82801

- Archaeology — Wyoming State Historic Preservation Office
  2301 Central Ave.
  Cheyenne, WY 82002

- Hydrology — Mark Taylor, PG Hydrogeologist
  WDEQ-LQD, District III
  1866 South Sheridan Ave.
  Sheridan, WY 82801