APPENDIX G

ENERGY AND MINING LEASING AND DEVELOPMENT: PROCESS

Oil and Natural Gas

The BLM is responsible for managing oil and gas development on federal lands as well as those lands where the federal government retained the minerals and patented the surface. For National Forest System lands, BLM coordinates with the USFS, which is responsible for identifying lands available for leasing through their land use planning process. If a nominated lease is in conformance with the appropriate Forest Plan, the USFS will provide BLM with the terms and conditions to be made part of the leases offered. BLM cannot lease USFS lands without the consent of the USFS. BLM does not offer USFS lands on its own initiative. And BLM cannot issue a lease on USFS lands over the objection of the USFS.

The Minerals Leasing Act of 1920, and its subsequent amendments, make federal lands available for oil and gas leasing. Both the BLM and USFS identify the lands open to oil and gas leasing in their Land Use Plans (LUPs) and outline the impacts that will occur from reasonably foreseen oil and gas development. To minimize impacts to other resource values and land-uses, the LUPs identify any stipulations to mitigate these impacts, which are attached to the lease and modify the lease terms. Federal policy allows for leasing decisions to be revisited when significant new scientific information becomes available.

For federal lands, BLM has regulatory responsibility for managing oil and gas leasing, exploration, development and production. This management responsibility generally entails issuance of a site-specific permit. Dependent upon the activity proposed, analysis of the proposed action under the National Environmental Policy Act (NEPA) may be required. In those cases where the surface was patented and the BLM retained the minerals, the same processes apply except the mineral lessee or owner is required to obtain a surface use agreement from the surface owner prior to permit approval. On non-federal lands, these processes are managed by the Colorado Oil and Gas Conservation Commission (COGCC). The NEPA analysis process is not applicable to the COGCC process on state or private minerals / non-federal land development.

Typically, oil and gas development occur in a sequential process. This process can be summarized as the following:

(1) Geophysical Exploration occurs (more detail follows). During this phase, the reservoir target is delineated. Geophysical exploration may occur before or after the leasing stage as well.

(2) Leasing Stage. An LUP or associated amendment is developed using the NEPA process. Land that is available for oil and gas leasing is identified and stipulations are developed to mitigate impacts. Once a lease is granted, the oil and gas operator has a legal right to reasonable use of the surface within the lease for exploration and development, within the stipulation attributed to each parcel.

(3) Drilling Operations (more detail follows). An Application for Permit to Drill (APD) is submitted, and if approved, an exploratory well is drilled. If the result is a “dry hole”, the well is plugged and reclamation occurs. If the well is successful, production operations

occur. If the geologic prospect warrants additional development, other APDs are submitted and if approved, more exploratory wells are drilled until the limits of the geologic prospect are defined. Additional development drilling can occur at this point. These are development wells and fall under "Production Operations" (see (4)).

(4) Production Operations (more detail follows). If a gas well is completed, rights-of-way for pipelines, powerlines, etc., are obtained and installed. Production equipment is installed on the wellpad and production begins. Interim reclamation of the well pad occurs. The operator makes visits to the wellpad to make sure operations proceed properly and to adjust equipment. Operator submits sundry notices for other operations requiring approval, along with additional APDs. As a well becomes depleted, the operator obtains approval to plug the well and conduct reclamation operations.

To help with development of the conservation strategies, more detailed descriptions of typical oil and gas development stages follow, including clarification of which types of activities require various government leases and approvals.

"Geophysical exploration" is a general term used for various indirect exploration methods that use geophysical instruments and methods to determine subsurface condition (i.e., the potential for oil and gas) by analysis of such properties as specific gravity, electrical conductivity, or magnetic susceptibility. A geophysical survey is the use of one or more geophysical techniques in geophysical exploration, such as earth currents, electrical, infrared, heat flow, magnetic, radioactivity and seismic activity. Most modern seismic exploration is based on the collection of data over a 2- or 3-dimensional grid. This requires thousands of geophones (instruments that detect Earth motions) placed on the ground and recording systems capable of recording ground motion from as many sites. The seismic wave is typically generated by either using a surface vibrator, i.e., a Vibroseis truck, or by an explosive source.

When a Vibroseis truck is used as the source, it travels to a pre-determined location where it stops, lowers a metal plate, and vibrates for a specific time. This process is repeated throughout the project area. The Vibroseis trucks travel to the source locations via existing roads and/or trails, or cross county.

When an explosive source is used, explosive materials are placed at pre-determined locations and exploded. They are either placed in a drilled shot hole and exploded, or placed on the surface and exploded. When placed in a drilled shot hole, a small portable drill rig is utilized. The portable drill rig can be driven to the pre-determined locations via existing roads and/or trails or cross county or alternatively for inaccessible locations, it is delivered via helicopter.

Federal approval to perform geophysical operations is required on surface lands administered by BLM or Forest Service. However, an oil and gas lease is not required to perform geophysical operations on federal lands. There are 2 ways in which to request approval of geophysical operations on federal lands: (1) via filing of a Notice of Intent (NOI) to perform geophysical operations; or (2) via a sundry notice if requested under the terms of an oil and gas lease. The NOI process doesn't apply to private surface while a sundry notice may. Either way, the procedures for processing a NOI or sundry notice are similar. Onsite inspections will be scheduled, appropriate natural resource/cultural clearances will be performed and mitigation measures or avoidance alternatives will be developed. The appropriate level of NEPA document will be prepared dependent upon the proposal. Any approval of the NOI will incorporate the mitigation measures identified at the onsite inspections.

Drilling and production operations include all actions/phases associated with drilling and producing an oil or gas well. There are multiple sequential steps which occur. A detailed discussion follows.

Drill Pad Construction

An oil or gas well requires the construction of a level, structurally competent location for placement of the drilling rig and associated equipment. Typical drill pads require an average of between 2 acres for single wells and 5 acres where multiple wells are drilled from 1 surface location. Drill pads are cleared of all vegetation using a bulldozer or other earth-moving equipment. Topsoil is usually removed and stored for use in reclaiming the site. An access road to the drilling location will also be constructed to transport the drilling rig, materials, and well servicing equipment to the site. These roads have a driving surface that is usually 16 - 18 feet wide, and an assumed total disturbed width of 35 feet. Gross vehicle weights of vehicles using these roads may exceed 80,000 lbs. One or two earthen pits will be constructed for storing drill cuttings and drilling mud reserves during drilling. Pits are usually unlined but may be lined with plastic or bentonite clay to prevent fluid loss or contamination of subsurface water resources. Pitless or self-contained drilling systems are sometimes called for in areas of high ground water or sensitive resource values. These systems substitute portable tanks of water and drilling mud reserves and may include a centrifuge system to remove solids from drilling fluids. The site preparation process may last from a few days to several weeks, depending upon the length of access road and size of drilling pad that will be constructed.

Drilling Operations

Oil and gas wells are drilled primarily with rotary drilling rigs. In the rotary method, a hole is drilled by means of a rotating bit to which a downward force is applied. The bit is attached to, and rotated by, a drill string composed of drill pipe and drill collars, with new sections of pipe being added as drilling progresses. Drill cuttings are lifted from the hole by the drilling mud, which is continuously pumped down the drill string through nozzles in the bit and upward through the annular space between the drill pipe and the hole. At the surface, the drilling mud is diverted to tanks or pits for cleaning and treatment. Drilling mud typically has several additives that are used to enhance the properties of the fluid. Typical mud additives include:

• weighting materials to increase the density of the mud
• corrosion inhibitors to protect metal components from corrosion
• dispersants to break up solid clusters of clay particles
• flocculants to cause suspended particles to group together for removal by settling
• surfactants, such as fatty acids and soaps, to defoam and emulsify the mud
• biocides to kill bacteria that may be inhabiting the mud
• fluid loss reducers such as starch and polymers to limit the loss of drilling fluid to subsurface formations

As the hole is drilled, casing is placed in the hole to prevent caving, and to isolate water- and hydrocarbon-bearing zones. Three or four separate casing strings may be used in wells. Casing is secured in place by pumping cement down the inside of the casing, which travels to the bottom of the borehole, then upward into the annular space between the casing and the hole. Following setting of the casing and any surface equipment, the drilling rig is moved from the well location. Drill cuttings are usually allowed to dry, and are then buried in the pit where they accumulated during well completion.

Directional drilling, where geologically and technically feasible, may be employed to reduce the amount of surface disturbance necessary to drill wells or to reach bottom-hole locations that may not be accessible from the surface with a straight hole. More than 1 well can be drilled from a single surface location using this technology, with the objective of effectively accessing the producing horizon beneath areas where surface disturbance is not permitted. A directionally drilled well is more costly to drill than a vertical well to the same depth. Following setting of the casing and any surface equipment, the drilling rig is moved from the well location. Drill cuttings are usually buried in the pit where they were accumulated during well drilling.

Well Completion

After drilling the well, several steps are required to start production. Well completion operations are generally performed by a completion rig (a small, truck-mounted rig used to complete the well and install downhole equipment). The casing and cement must be perforated to enable gas to enter the well bore. Several producing zones may be perforated by means of small, shaped explosive charges that create holes in the casing and cement. Most reservoirs in northwestern Colorado are considered low-permeability reservoirs and require hydraulic fracturing in order to produce at economic flow rates. Hydraulic fracturing is accomplished by pumping a water-based viscous fluid and sand down the well at high pressures and flow rates. After the fracture gradient (the pressure where the formation begins to break down) for the zone is reached and exceeded, the formation fractures and begins taking the fluid and remains propped open after pumping stops and pressure is released. The propped fracture provides a high-permeability channel for gas to enter the well bore. In some wells, hydrochloric or hydrofluoric acid may be pumped into the producing formation to enhance permeability. Gas production from the well is controlled using an assembly of pipes, valves, and fittings at the surface (called the "Christmas tree"). Following completion, a well is allowed to flow back to the pit, which removes any excess fracturing fluid, spent acid, and remaining sand in the well bore. Any gas and oil that comes to the surface is burned off, or "flared." Some operators use specialized separation equipment, referred to as a super separator, to decrease the need for flaring. The well is then shut-in until connected to a gas flowline.

Production Operations

Produced fluid flows from the wellhead into an onsite separator that removes water and condensate from the flow line. Natural gas is directed from the separator into a flowline, a 2- to 4-inch-diameter pipeline leading to a trunk line or natural gas compressor. Flowlines are usually buried but can be laid on the ground surface. Within the field area, flowlines will primarily be built along the existing access road to minimize surface disturbance. Water and condensate are stored in onsite tanks and are periodically removed by truck. The condensate is sold and the water is transported to an approved disposal facility. Trunk lines gather gas from a number of producing wells and are usually 6 to 8 inches in diameter and buried. Compressors are used to move gas from flowlines and trunk lines into transmission lines. Compressor stations range in size from one acre to as much as 20 acres, depending upon the number of compressors required and the need for additional support infrastructure. Transmission lines range from 10 to 36 inches in diameter and transport natural gas to a facility to be conditioned for ultimate sale to a purchaser.

Natural gas wells may periodically require maintenance procedures called workovers. Workovers are performed using a completion rig and may include (1) repairing leaks in the casing, tubing, or other downhole equipment; (2) re-completing the well in additional producing formations; (3) stimulating the well with supplemental fracturing or acid treatments; or (4) removing scale and other accumulated deposits. Workovers may take one day to several days to complete, depending upon the complexity of the tasks to be undertaken. Surface equipment may also require periodic maintenance. Valves, piping, tanks, and separators may require repair, cleaning, and adjustment. Each well is visited on a regular basis by the operator, who checks on the performance of the well, gas condensate and water tanks, and is responsible for the proper functioning of the production equipment. The frequency of these visits may range from once per day to once per week. Some operators use solar-powered remote telemetry facilities to monitor well performance, reducing the number of visits to the well site. Oil wells have operations similar to gas wells, although they typically require a pumping unit such as a pump jack.

Reclamation and Abandonment

Disturbed areas are partially reclaimed following well completion, based on a BLM-approved reclamation plan. This includes reclamation on that portion of disturbed areas which is not considered necessary during well production. Abandoned well locations are reclaimed. Reclamation requirements are contained in the Conditions of Approval (COAs) applied by BLM during the permitting process. Well abandonment involves placing cement plugs in the well bore to prevent fluid migration. Surface facilities are removed and the well is capped below the ground surface. Buried pipelines are usually left in place but plugged at intervals as a safety precaution.

Approvals

Drilling operations on federal oil and gas leases require an approved APD. The operating regulations used to permit an oil and gas well are found in 43 CFR Part 3160. These regulations are implemented and supplemented with a set of Onshore Oil and Gas Orders. The Orders are also regulations and carry the full force and effect of regulation. A well must be drilled in order to produce oil and/or gas from the lease. There are 2 ways to initiate permitting of a well, either via a Notice of Staking (NOS), followed by the submittal of an APD, or directly through submittal of an APD.

Before drilling a well, the lessee, or an operator for the lease, must file an APD. The operator must file an application with the BLM Field Office in which the action will take place. The application must include, in part, a plan for the drilling of the well and a plan for the protection of the surface and environment. The drilling plan contains information as to the depth of the well, how it will be constructed, how ground water and other mineral resources will be protected, and how blowouts and other emergencies will be prevented or dealt with. The surface use plan describes the access road, drill pad and construction methods. It also includes proposed reclamation and mitigation of impacts to wildlife, cultural resources, vegetation, soils, surface water, and other land-uses and values. For wells on National Forest System lands, the USFS approves the surface use plan. If the appropriate information and mitigation is not incorporated into the APD, the application may be modified or rejected. RMP decisions are incorporated by attaching stipulations to the lease and COAs to the APD. Onshore Oil and Gas Order No. 1 requires a field (onsite) inspection as part of the review of an APD. The inspection is a meeting between the parties to explain and clarify the proposed action.

The NEPA process provides written documentation of the environmental review for an APD and the development of mitigation (COAs; see below). The NEPA process also serves as the vehicle to check for conformance with the RMP. At the site-specific level, Environmental Assessments (EAs) are prepared for a majority of APDs in Colorado. In cases where the proposed well is obviously part of a larger field development, and such development has not already been analyzed by a NEPA document other than the RMP, a Field Development EA can be prepared.

Another component of the review process is the technical review of the drilling plan portion of the APD. The APD review by the field office (FO) geologist includes the following items: (1) geological markers and formation tops; (2) oil, gas, and mineral-bearing zones; (3) potential hazards such as abnormal pressure; (4) casing set points; and (5) cement tops. A geologic review report documents the review and is incorporated into the APD case file. The APD review by the FO petroleum engineer includes the following items: (1) casing and cement program; (2) drilling fluid program; (3) pressure control system; and (4) testing, coring, and logging.

When all of the resource specialists have accumulated all of the information about the proposed well operation, they determine requirements for site-specific environmental protection. As part of the impact analysis, each specialist must determine whether the APD needs to be supplemented with additional impact mitigation measures. These measures are called COAs. However, these mitigation measures are distinct from stipulations that are attached to the lease. COAs are developed through the NEPA compliance process for each APD. Stipulations which are attached to the lease are developed through the planning process. The COAs must be reasonable. This means they must be technically possible to accomplish, and they must allow the exercise of lease rights. They must also be plainly worded and justified by the NEPA process. A COA must not prevent an applicant from proceeding with development for either economic or technical reasons.

Once all of the BLM staff specialists have reviewed the APD and determined that the surface use plan and drilling plan are in compliance with BLM regulations, and all other impacts are addressed in the appropriate NEPA document, the APD is ready for approval, providing that the mandatory 30-day posting period has elapsed. At this point, COAs are attached to the APD, and the FO Manager signs and dates the APD. The approved APD is valid for one year, with a one-time extension of up to one year, if requested.

After the well is drilled, certain subsequent well operations require BLM approval via a sundry notice, Form 3160-5. Generally, any work on the wellbore, additional surface disturbance and changes to oil and gas measurement equipment require BLM approval prior to performing the work. During production, field operations are inspected by the BLM to assure accountability for royalties, compliance with the lease, permit safety, and environmental requirements.

The final stage in the life of an oil or gas well usually occurs when it is depleted and can no longer produce in paying quantities. At this stage, the operator submits a plug and abandonment plan which is reviewed and, if necessary, modified by the BLM petroleum engineer prior to approval. When the downhole plugging is completed, the operator submits a subsequent Report of Abandonment which is reviewed by the BLM. When surface reclamation is completed and vegetation has been reestablished, usually in 2 to 3 growing seasons, the operator will submit another subsequent report of a Final Abandonment Notice (FAN). The BLM will inspect the location to determine whether it was reclaimed properly, and if so, approve the FAN.

Coal Bed Methane

Coal bed methane (CBM), also known as natural gas from coal seams and coal bed natural gas, is one of the most important and valuable resources in the Western United States. The natural gas that results from CBM development is a clean burning fossil fuel.

CBM development follows a similar process for Oil and Gas (O&G) development in that reserves are first leased, and natural gas is extracted through the drilling of wells. Generally, water produced by CBM development in Colorado is either re-injected back into the well or hauled away via truck. CBM associated facilities and their potential impacts to GrSG are similar to those expected during O&G production. Potential areas for CBM development typically overlap with other O&G operations and are considered during the RFD process in LUPs.

Oil Shale

Recently enacted legislation (Energy Policy Act of 2005, H.R.6, Section 369) instructed the Department of Interior to make available for leasing (from lands already identified as being available for oil and gas leasing) federal oil shale lands within 6 months after enactment of HR6, for research and development of technologies for the recovery of liquid fuel from oil shale and tar sands on public lands.

The legislation also required the DOI to prepare a Programmatic Environmental Impact Statement (PEIS) for a commercial leasing program for oil shale and tar sands resources. This document will only allocate lands to make them available for the opportunity to lease. Additional NEPA will be required prior to leasing. The Draft PEIS is expected to be completed in late 2007/early 2008. The Record of Decision (ROD) is anticipated late in 2008. The Final Regulations are required 6 months after the draft PEIS is completed. The PEIS will examine 3 oil shale extraction technologies: underground and surface mining with surface retorting, as well as the in-situ retorting process. In-situ retorting involves heating the oil shale while it is still in the ground. One method involves electric heating elements, which would be placed in bore holes, heating the shale to approximately 700 degrees for 3-4 years. The released liquids are gathered in wells specifically designed for that purpose.

The majority of the high potential areas for oil shale development in Colorado are within the BLM's White River Resource Area (WRRA), in Rio Blanco County (S. Thompson, Bureau of Land Management, personal communication). The Resource Management Plan (RMP; Bureau of Land Management 1997) for the WRFO has Resource Decisions that cover the lands available for leasing and development of oil shale. A summary of those decisions are as follows:

1) A total of 223, 860 acres will be available for oil shale leasing;
2) 39,140 acres will be available for open pit development; and
3) 70,820 acres will be available for multi-mineral (oil shale, nahcolite, and dawsonite) leasing following development of acceptable multi-mineral recovery technology.

The above areas are generally considered to be the "high potential" oil shale areas within Colorado (see Fig. 22, pg. 114). The PEIS will amend the White River RMP, as well as the Little Snake RMP, Grand Junction RMP and GSRMP, so these numbers could change in the future.

Mining

Sodium (or trona) is produced by solution mining and consists of a group of wells for injection of hot water and retrieval of dissolved nahcolite, a collection pipeline, roads, and a processing plant. Coal, uranium, gravel, and other mineral mining activities may be conducted through surface mining, pit mining, strip mining or underground mining operations (see also “Energy and Mineral Development” issues section, pg. 109).