Best Management Practices for Electric Utilities in Greater Sage-Grouse Habitat

DRAFT

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1.0 Executive Summary

2.0 List of Contributing Authors/Participating Organizations

3.0 Purpose

Increasing demands for energy and for the development of renewable energy sources require new power lines be built to transmit electricity from where it is generated, which is often in remote areas, to more populated load centers. Wildlife scientists and public land managers are concerned these new, tall high voltage transmission and distribution structures may impact sage-grouse and their habitat. Siting guidelines and stipulations vary between state and federal agencies, as well as among different field offices within the same federal agency. The effectiveness of existing lek buffers, seasonal construction or maintenance restrictions, and other agency required stipulations have not been evaluated.

APLIC and its agency partners have prepared this document to assist member utilities in implementation of best management practices for minimizing impacts to Greater Sage-grouse and their habitats for the construction of new facilities and maintenance and re-permitting of existing facilities. Utilities are required to obtain rights-of-way (ROW) grants, special use permits, easements, or other permits to construct and maintain facilities on federal, state, and private lands. These permits, grants, and easements must comply with existing Resource Management Plans, Forest Management Plans and/or local land use plans. In order to identify appropriate and effective best management practices for utility activities in sage-grouse habitat, it is important to understand how a utility operates and how environmental concerns/requirements can be incorporated at various stages of the life of a power line facility (e.g., siting, construction, and maintenance. Sections 5 and 6 of this document detail typical utility construction, operations, and maintenance activities.

This document also provides an overview of the following

- Regulatory statutes utilities operate under federal, state and local levels (see Section 4).
- A description of typical utility operational and maintenance activities, including vegetation management programs, pole repairs, structure replacements, etc. (see Section 6)
- A summary of current recommended best management practices to site, permit, construct, operate, and maintain existing and new power lines and associated infrastructure (e.g., access roads) to minimize impacts to sage-grouse and their habitat (see Section 7).

Consideration of sage-grouse habitat into the early planning phases of a new construction project or a larger maintenance project is necessary to ensure measures are implemented to avoid and or minimize impacts to the natural and human environment to the greatest extent feasible. Since many power lines in sage-grouse habitat are located on federal lands, it is important for land managers and resource agencies to understand construction, operational, maintenance, and inspection requirements for power lines, what type of equipment is required for various activities, what types of impacts are expected from various construction and maintenance activities, and how frequently the work is performed. It is also important to understand an electric utility's ongoing needs to access its power lines in order to perform necessary and required inspections and maintenance activities, and to upgrade existing facilities or construct new facilities to meet ongoing energy demands.

The BMPs presented in this document are intended to serve as a "tool box" from which a utility can select and tailor components applicable to its specific needs. These guidelines are intended to be used in conjunction with APLIC's *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006,* and *Reducing Bird Collisions with Power Lines: The State of the Art in 2012*, or the most current editions of these documents, as well as the APLIC and Service's 2005 *Avian Protection Plan Guidelines.* Utilities within sage-grouse range may choose to reference or incorporate these BMPs into their company Avian Protection Plan (APP). This BMP document is intended to be a dynamic document that will be periodically updated to reflect new science, techniques, resources, or regulatory requirements. Because many BMPs intended to minimize impacts to sage-grouse and their habitat have had limited effectiveness monitoring, utilities and agencies that implement these BMPs are encouraged to evaluate their effectiveness and communicate this information with others. Such information could help inform future revisions of this document.

4.0 Background

The Western Association of Fish and Wildlife Agencies (WAFWA) convened a diverse group of stakeholders to identify problems and strategies to conserve Greater sage-grouse (sage-grouse). This forum developed the *Greater Sage-grouse Comprehensive Conservation Strategy* (2006), and in that document, recognized the need to assess the potential effect tall structures may have on sage-grouse. The following four goals were identified in Appendix C, pages 29-31 of the *Strategy* document:

1. Compile and evaluate published research on the effects on sage-grouse due to impacts of existing tall structures.

2. Develop research protocols to conduct new studies to assess impacts of tall structures.

3. Develop scientific and consistent siting and operation and maintenance (O&M) criteria for tall structures in sage-grouse habitat to minimize negative impacts on sage-grouse.

4. Develop BMPs and appropriate mitigation measures to implement for siting and O&M activities associated with tall structures.

in 2010, the U.S. Fish and Wildlife Service (FWS) placed sage-grouse on the list of species that are candidates for protection under the Endangered Species Act (ESA). One reason cited in the decision is the lack of adequate regulatory mechanisms to protect sage-grouse. Infrastructure development, including power lines, is believed to cause avoidance behavior, increased avian predation and habitat fragmentation, but research was needed to determine if these were occurring and contributing to sage-grouse population declines.

Under the direction and support of WAFWA and its Sage-grouse Executive Oversight Committee (EOC), Utah Wildlife in Need (UWIN) and its partners initiated an inclusive, consensus-based process to address and attain the four goals identified in the WAFWA *Strategy* document.

In September 2010, with UWIN's publication of *Contemporary Knowledge and Research Needs Regarding the Effects of Tall Structures on Sage-grouse* (www.utahcbcp.org) **Goal 1** was addressed. The document reported that no peer-reviewed, experimental studies either confirmed or denied the effects of tall structures on sage-grouse and that additional research is required to effectively evaluate/ascertain the potential impacts.

Sage-grouse researchers, statisticians, wildlife biologists, public and private land managers, and energy representatives developed a study design protocol (Protocol) to assess impacts on sage-grouse from tall structures, particularly high voltage power lines. The Protocol is designed to address three specific research questions:

• Do sage-grouse avoid tall structures and if so, why?

• Do tall structures increase avian predation by providing increased nesting and perching opportunities? If there is an increase in avian predation, is it significant to sage-grouse on a population level?

• Do tall structures create fragmentation of habitat that limits use or movement of sage-grouse?

The Protocol recommends rigorous, replicated research based on a "Before-After-Control-Impact" (BACI) study approach. Several representatives that developed this protocol also participated in the published National Wind Coordinating Committee (NWCC) research protocols to assess potential impacts of wind energy facilities on sage-grouse. In July 2011, with UWIN's publication of *Protocol for Investigating the Effects of Tall Structures on Sage-grouse (Centrocercus spp.) within Designated Energy Corridors* (www.utahcbcp.org) **Goal 2** was attained.

On September 13, 2011 the EOC adopted the *Protocol* as a minimum protocol for researching the impacts of electric transmission and distribution lines on sage-grouse populations and habitat [placeholder for link to WAFWA SG EOC white paper referencing endorsement of the research protocols]. Further, the EOC adopted a series of recommendations from the Range-wide Sage-grouse Interagency Conservation team (RISCT) regarding participation in the studies, determining study sites and funding research opportunities by using a portion of a project's "unknown impacts" mitigation budget. This approach is also supported by state and federal resource agencies in order to provide data on a large geographical scale to inform management decisions.

Research that follows the Protocol is necessary to adequately address **Goal 3** (siting and O&M) criteria) and **Goal 4** (BMPs). However, because of the long timeframe required to conduct multi-year BACI studies, the need for interim and adaptive BMPs was identified by the electric utility industry through the Avian Power Line Interaction Committee (APLIC). In October 2012, APLIC convened a sage-grouse/power line meeting and invited representatives from electric utilities, academia, and state and federal agencies. The group agreed there was a need for these BMPs and committed to develop them. This document is a result of this effort among utilities and agencies.

4.1 APLIC Members Commitment to the Environment

In 1989, biologists from the utility industry, USFWS, and the National Audubon Society formed APLIC, initially to address collision issues of sandhill and whooping cranes. The scope of APLIC's mission later expanded to include electrocution and nest issues, and in recent years has also expanded to address avian concerns associated with construction of new transmission infrastructure. APLIC serves as a clearinghouse for information and communication on avian/power line issues. Its membership includes electric utilities, Edison Electric Institute (EEI), Electric Power Research Institute (EPRI), National Rural Electric Cooperative Association (NRECA), Rural Utilities Service (RUS) and USFWS. APLIC's mission is: [add mission statement]. Since the 1970s, APLIC has produced and updated manuals for addressing electrocutions (*Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006*) as well as collisions (*Reducing Bird Collisions with Power Lines: The State of the Art in 2012*). In 2005 APLIC and the USFWS released joint *Avian Protection Plan Guidelines,* which offer a "toolbox" for utilities to address avian issues. In addition, APLIC offers several short courses annually that provide an overview of avian/power line issues and solutions, including collisions, electrocutions, nests on utility structures, and construction impacts. APLIC also funds bird/power line research and has sub-groups that address species-specific considerations, such as sage-grouse.

APLIC member utilities consist of rural electrical cooperatives, investor owned electric utility companies, and multi-state federal and private transmission companies in the U.S. and Canada. The service territories of APLIC member utilities that occur in sage-grouse range cover about xxxxxx square miles, with member companies located throughout all sage-grouse occupied states and serving thousands of communities and millions of customers. This infrastructure includes transmission lines, overhead distribution lines, underground distribution lines, substations, and interconnects with other utilities serving others outside this area (See Section 4.5 for terminology descriptions). Much of this existing infrastructure located in rural areas also crosses sagebrush steppe, pasture, or grassland habitats occupied by sage-grouse.

APLIC member utilities are committed to operating and maintaining their power lines in ways that minimize impacts to the environment, particularly birds and other wildlife and their habitats. To that end, typical utility work would include efforts to:

- Conduct maintenance activities with due regard to preventing damage to vegetation, timber, soil, crops, roads and improvements, and preventing water and soil pollution.
- Avoid intentional harm to biological resources.
- Respect cultural and historic properties.
- Reclaim vegetation and soil disturbed by required maintenance or new construction activities to as near as possible its original condition or possible improved condition at the completion of activities.
- Remove any waste material generated because of its activities or operations.
- Provide environmental awareness training to employees and contractors regarding potential impacts to biological and environmental resources from their activities.
- Fully comply with the provisions of all applicable state and federal environmental laws and regulations or ROW stipulations.

4.2 Utility Regulatory and Reliability Considerations (expand)

Comment [SL1]: Does EEI have language to add to this section? Need info on FERC, NERC, PUCs, regulatory commissions, etc.

A key factor in providing reliable electricity is regular inspection and maintenance of power lines and associated facilities (substations, access roads, fiber optics, etc). Congress has recognized the fact that many power lines are in need of repair or upgrade as illustrated by language contained in the Energy Policy Act of 2005. Among other things, the Act establishes mandatory reliability standards for power lines and provides incentives to transmission companies to upgrade and maintain existing facilities. State Public Service Commissions have also imposed inspection and corrective maintenance requirements upon utilities doing business within their states. Electric utilities are required to provide electrical service to customers and may upgrade existing power lines and other facilities as well as construct additional power lines and generating capacity as necessary to meet customer needs.

a. FERC , NERC, WHEC, PUC's
    - Construction standards
    - Standards and guidelines for reliability
    - Reliability in a catastrophic event (e.g. wildfire, windstorm, plane crash)
    - Requirement for voltage (minimal separations)
    - Audits
    - Potential fines

Comment [SL2]: Need to flush out this outline with text

b. Meeting Customer Demand, and Remaining in Compliance with PUC/Reliability Commitments
    - Double circuit lines and effectiveness/ reliability

- Transmission versus distribution: demand
- Demand for renewable energy and new powerlines for support
- Growth and need for new facilities to carry generation (each customer is equal)
- Co-locating lines and remaining reliable
- Utility customers guarantees
- Power requirements for industrial customers : uninterrupted service, high loads
- Critical services, need uninterrupted services (i.e. hospitals)

4.3 Existing and Future Utility Corridors

A Western Utility Group study of strategic utility corridors in 1992 identified the value and necessity of regional transmission lines in the western United States. That study identified all existing electric transmission lines located across the western United States and, with the cooperation of numerous federal and state agencies, designated new transmission corridors or existing lines as strategically important because of their significance in providing intrastate and interstate energy services to the western US. Many of the utility corridors identified as strategically important contain one or more of APLIC member's power lines. (expand discussion on WECC and designated energy corridors)

Identification of new energy corridors on western federally managed lands is required in the Energy Policy Act (expand discussion). This includes placement of new facilities and designation of energy corridor siting opportunities through the region on BLM and Forest Service-administered lands, except wilderness study areas and some special management areas (including areas of critical environmental concern). APLIC member utilities provided comment and identified potential corridors during the Western Energy Corridor Programmatic EIS process. Recommendations included new facilities would be placed in or adjacent to existing infrastructure within designated energy corridors, when possible, but not adjacent to each other if safety, reliability or resource conflict issues were identified. Areas with important or sensitive resource values would be avoided, whenever possible. Specific proposals would require site-specific environmental analysis and compliance with established local, state and federal permitting and siting processes.

Comment [EH3]: This EIS was challenged and there is a final settlement that we might need to reference. One of the proposed corridors (ironically enough would bisect one of the largest populations of Gunnison Sage-grouse in Colorado-which was he reason this route was challenged.
Per Diana Leikert

Activities generally excluded from or restricted within transmission (high voltage) utility corridors include mining, materials storage and disposal, range and wildlife habitat improvements involving facility construction, non-linear energy project development, blasting, excavation, and high profile (tall) facility development.

Comment [EH4]: I guess it would depend on the improvement?
Per Diana Leikert

Item for discussion: reword or omit this?

4.4 Environmental Permitting and Compliance Considerations (expand)

Comment [SL5]: Need language here re ESA, NEPA, MBTA, etc.

a. National Environmental Policy Act (NEPA), Management Plans
- NEPA process that evaluates impacts and authorizes uses due to finding of no significant impact (FONSI)
- BLM/USFS management plans that identify compatible and authorized uses

b. Endangered Species Act, greater sage-grouse listing potential

Comment [UF&WS6]: Should reference the COT Report somewhere in sec 4.4

- September 30, 2015 is the end of the USFWS fiscal year, and listing decision deadline
- Federal agencies seeking opportunities to conserve habitat through regulatory and voluntary mechanisms (BLM, Forest Service, NRCS)

c. Compliance with objectives included in federal resource management plans, resource management plans, State Department of Natural Resources, and local land use plans including specific objective for but not limited to:
- Threatened, Endangered, Candidate and Proposed Wildlife and Plant Species
- Species of Concern
- Range and Vegetation Management
- Surface water, wetland, floodplain, and riparian area protection
- Invasive and noxious weed management

4.? For group discussion – need to determine appropriate place to add section on potential conflicting operational and environmental regulations (e.g., vegetation and fire management requirements, redundancy, structure design and undergrounding limitations, required maintenance, etc. and how these requirements may conflict with sage-grouse buffers, etc.)

4.5 Overview of Power Line Infrastructure and Terminology

Electric utility companies may own and operate facilities where electrical energy is generated and then delivered to their customers. These electrical generation sources could be coal or gas fired, nuclear or renewable facilities such as hydroelectric, geothermal, wind or solar. Power lines are rated and categorized, in part, by the level of electrical voltage they carry. Because the amount of electricity is large, voltage is usually specified as kilovolts (kV), where 1 kV is equal to 1,000 volts (V). In a power system, from the power generation facility to the customer (see Figure #), four voltage classifications are used: power source, transmission, distribution, and utilization, (see Table #). Although there are exceptions to these voltage classifications, they hold in general and will be used throughout this document. Voltage classification also depends on the purpose a power line serves. Transmission lines (≥60 to 765 kV) are used to transmit large blocks of electricity from the power generation facility to the load centers (communities). Within load centers, the high voltage of transmission lines is reduced at substations and then delivered via distribution lines (2.4 to 60 kV) for residential, commercial, and industrial uses. The distribution voltages are again stepped down to the lower voltages for the end user (120 to 600 V) usually by pole- and pad-mounted transformers. Both transmission and distribution lines (see Figure #) are power lines, a term used throughout this document.

A power line's voltage, configuration, conductor spacing, location, and structure type are determined by the present and anticipated power demands or load requirements the line will serve. Because electric utilities are required by law to provide reliable electrical service, they plan, fund, and build new power lines. If enough power is available in an area, then building new distribution lines can sometimes meet the increasing demand. Alternatively or additionally, transmission lines can be built to bring power to the load center from distant power generation facilities. Transmission line corridors are determined by the location of power generation facilities and substations in relation to load centers. Within the corridor, the preferred and alternative routes are determined, among other things, by rights-of-way (ROWs) availability, land use patterns, potential environmental impacts, terrain, archeological sites, proximity to habitable dwellings, and crossings over water, highways, and other power lines (see APLIC 2012 for a discussion and illustration of the new line planning process). Current renewable energy mandates are leading to the development of wind, solar, and other renewable sources. Because these renewable energy sources are typically remote, new transmission lines are often needed to connect them to the grid and carry electricity to load centers.

Different ROW widths are required for different transmission line voltage ratings; these are generally determined by state statutes and the National Electrical Safety Code. ROW widths are also a function of structure height, span length, the conductor height above ground, and the low point of the conductor. ROW widths for transmission lines will vary from 15.2 m (50 ft) to more than 60.9 m (200 ft). Because ROWs are becoming increasingly difficult to obtain it is a common practice to increase the voltage levels of lines in existing ROWs when statutes and safety allow. As voltages increase, the amount of power that can be transmitted increases by a greater multiple.

Electric utilities install power lines either overhead or underground depending upon numerous considerations. Some key factors include customer needs, costs, code requirements, terrain, voltage, and technological and environmental restrictions. Cost is a major concern as electric utilities have mandates to serve customers with high quality, reliable electric service at the lowest cost possible. Power lines, particularly residential distribution lines, may be installed underground in areas where it has been found technically and financially feasible to do so. However, at transmission voltages, there are many more areas where installing lines underground is not feasible. Likewise, environmental concerns may preclude underground installation of power lines of both transmission and distribution voltages. See Section # for a more detailed discussion of underground power line considerations.

5.0 Utility Construction Activities – (needs to be put into a narrative)

I. Construction Footprint
   a. Access roads
      i. Size, type, minimum requirement for needs
   b. Add language regarding "typical" construction activities for new transmission and distribution lines (footprint size and shape, duration, ground disturbance, equipment, etc.). BMP section would then address how SAGR considerations would be included in construction planning and actions.

Comment [EH7]: Recommend putting this up at the top(I) so the reader understands the process and potential impacts and then delve into the BMPS used to minimize impacts to grouse?

6.0 Utility Maintenance Activities

6.1 Access Requirements

Federal land managers administer ROW grants and issue easements on federal lands for construction, operation and maintenance of power lines. Pre FLMPA grants and easement language may or may not be clear on right of or designated access routes to existing power lines but the right to maintain and operate is either directly expressed or implicitly understood in each grant or easement. In many cases, a utility's ROW grants and easements permit the construction, operation and maintenance of an "Electric Power Line" and authorize access to the power line and ROW. Most federal land managers recognize the need for a utility to access its power lines since the operation, maintenance and emergency repair of the power lines cannot be accomplished without reasonable access for vehicles and personnel. In most situations, this can be accomplished by using historical or existing roads and trails but in some cases, the use of overland travel or improvement to historic access routes is required. The current condition of many power line access roads is adequate for routine line maintenance activities, while in some situations there may be a need for access road maintenance or improvements (generally site-specific activities), or access road relocation. Improving or relocating access roads is generally not conducted without the expressed authorization of the land managing agency unless under emergencies.

Most RMPs or Forest Plans restrict the use of off road vehicles, including over the snow, when ruts may result from vehicles in wet soils, in areas of sensitive resources such as occupied sage-grouse habitat, or in special management areas. APLIC members have power lines that serve facilities within some special management areas or have power lines within or adjacent to sage-grouse habitat. Because utilities must have access to inspect or repair their structures and facilities in these sensitive areas, this document includes BMPs to minimize impacts to these habitats.

In the event of an emergency, a utility must respond as quickly as possible to restore power and may be required to take actions beyond those authorized in its ROW grant(s). This may include construction of new access routes or improving access roads without prior review or approvals. In most cases, a land manager would be notified of the emergency and actions taken in concurrence with the utility responding to the emergency. The utility and resource agencies would then work together to identify and implement appropriate restoration or remedial measures after the emergency has been addressed.

6.2 Maintenance Requirements

Maintaining the tens of thousands of miles of power lines that cross sage-grouse habitat in the western U.S. requires the dedication of many employees and the use of various vehicles and equipment. Dispatchers located in strategic locations and urban areas manage the operations of energy loads on power lines. The flow and amount of electricity on a utility's lines is dictated by the size of the line, consumer demands, generation production, price, and available capacity on the power lines themselves.

Comment [SL8]: Isn't this the same as size of the line?

Field maintenance activities may include the following three categories:

- Routine maintenance (inspections, corrective actions, and vegetation management)
- Major corrective actions
- Emergency activities

Routine inspection and maintenance activities - are ordinary maintenance tasks (table 1) that have historically been performed and are regularly carried out on a routine basis within the bounds of the existing power line and access rights-of-way. These actions generally would not require new ground disturbances unless needed for access or to set up equipment in a safe position around the pole. These actions generally do not need additional land manager or agency approvals unless there is a federally listed species or eligible cultural resources in proximity to the work area because they are considered actions authorized under the ROW grant. Examples of routine inspections and maintenance activities may include:

Comment [EH9]: We might need to clarify some of these bullets because in some situations we would need to do road or pad improvements around the structure re to replace a cross arm or a pole. If you have a good pad site to set up your equipment no disturbance may be required but if your ROW is in poor access condition you would need to do some dirt work potentially.
Per Diana Leikert

- Safety Inspection (ground and aerial)
- Detail Inspection (ground)
- Wood Pole Test and Treat (ground)
- Outage Cause Inspection (aerial or ground)
- Corrective Routine Maintenance:
  - Adding Bird Protection Devices
  - Problem Nest Management
  - Insulator Replacement
  - Cross Arm Repair or Lowering
  - Cross Arm Replacement

        - Hardware Tightening
        - Conductor Repair
        - Guy Wire Tightening
        - Access Road Maintenance (removal of obstructions)
        - Pole replacement (same location)
    - Vegetation Management

- **Major corrective maintenance activities** (table 2) **-** are planned efforts that are relatively large in scale (either through number of poles, duration, ground disturbance, etc.) that occur on an infrequent basis, and may require ground disturbance within and outside of existing ROW. Facilities may require replacement due to human or natural caused damages, age of facility, or other factors. Proposed actions would require site-specific environmental analysis and compliance with established permitting processes. Examples of major corrective maintenance activities may include:
    - Conductor Replacement
    - Access Road Improvement and/or Relocation
    - Multiple Structure Relocation or Replacement

Comment [EH10]: Depends on the level of improvement? Tri-State considers annual access improvements as a minor action unless we have sensitive resources involved? We are requesting that routing access road maintenance is permitted inour new SUPs and ROW Grants. Relocation is a different story.
Per Diana Leikert

- **Emergency maintenance activities -** are those activities necessary to promptly restore electrical service or repair facilities in the event of a power outage or other emergency. These activities include the need to repair a power line or prevent additional damage to a line that would eliminate a human health or safety hazard and prevent damage to property or resources. Examples of emergency maintenance activities:
    - Restoration of Power/ Broken Equipment Replacement
    - Removal of Problem Bird Nest Causing Imminent Danger (see APLIC 2006)
    - Removal of Human Health and Safety Issue (e.g., downed power line)
    - Removal of Fire Risk
    - Removal of hazard trees/vegetation that pose an imminent threat to the power line
    - Oil spill response

6.2.1 Routine Maintenance and Inspections

Safety Inspection

Utilities are required to perform safety inspections of their power lines on a cycle that varies from multiple times per year to every few years. Inspection frequency will vary by location and voltage and is dictated by utility regulatory agencies. Inspections are performed by an inspector via a 4-wheel drive pickup, 4-wheel drive all-terrain vehicle (ATV), or from the air via a helicopter or fixed wing aircraft. In some cases, the inspector walks the ROW. The inspector assesses the condition of the power line structures, conductors, and hardware to determine if any components need repair or replacement, or if other conditions exist that require maintenance or modification activities. The inspector will also note any encroachments on the ROW that could constitute a safety hazard or are unauthorized. The inspector accesses locations along each line and uses binoculars and/or spotting scopes to perform this inspection.

Detailed Inspection

Detailed inspections of a utility's transmission and distribution line system may occur on a one- to ten-year cycle dependent on the criticality of the line segment as determined by the utilities management and local utility regulatory agencies. The inspector will access all structures of the identified line and check all equipment and other components to determine if repairs or maintenance activities are required. Inspectors performing this work use conventional 4-wheel drive trucks, 4-wheel drive ATV's, snowcats, or the inspector may walk the line. Helicopters are typically not utilized for detail inspections. Inspectors may view the line using binoculars and/or spotting scopes. Minor repairs to structures might also be done during detailed ground inspections.

Wood Pole Test and Treat

Many utilities have a wood pole test and treat program. Each pole could be tested on a five- to 20-year cycle. This program includes hand excavating around the wood pole, completing a detailed inspection of the ground line of the wood pole (to determine extent of wood rot) and re-treating the ground line portion of the wood pole if necessary. Core samples from the wood pole may also be taken, and poles treated with a chemical preservative. Access to structures is with four-wheel drive trucks or 4-wheel drive ATV's. Associated work included in the detail inspection may also be performed at this time. Impacts are limited to the area around the poles and would occur entirely within the permitted ROW.

Comment [EH11]: Not sure what the "ground line" is.

Outage Cause Inspection

In the event of an outage or interruption in the transmission and distribution of electricity on power lines, a utility will typically conduct an inspection (aerial or ground) to determine the cause of the interruption. Outage cause inspections utilize similar equipment and points of access as the other above listed inspections. In addition, trouble trucks (typically a 4-wheel drive truck with a personnel bucket to lift employees to the pole) are used to gain access to the pole for a lineman to determine the cause of the outage. Depending on the type of repair work needed and a utility's safety requirements, work may be done by a single troubleman or crew(s) may be needed. The type of repairs and needed crew compliment will dictate the number and type of vehicles used. This inspection may take place at any time of the day or night and result in emergency repairs.

Corrective Routine Maintenance

Routine maintenance activities are ordinary maintenance tasks historically performed and carried out on a regular basis and generally authorized under the ROW grant. The work performed is typically repair or replacement of individual components (no new ground disturbance), performed by a relatively small crew using a minimum of necessary equipment, and usually conducted within a period from a few hours up to a few days. Work requires access to the damaged portion of the line to allow for a safe and efficient repair of the facility. Equipment required for this work may include a 4-wheel drive truck, material (flatbed) truck, bucket truck (low reach), boom truck (high reach), excavator, or man lift. This work is scheduled and is typically required due to issues found during inspections. For non-emergency or non-urgent repairs, timing or seasonal restrictions can be considered when conducting this work within or that requires travel through designated greater sage-grouse habitat (see BMP section).

Responsibly conducted routine maintenance activities have little or no potential to disturb or unduly affect resources within ROWs or access roads and typically do not require additional permitting or review from land managers or resource agencies.

Vegetation Management

The objective of a utility's Vegetation Management Program is to manage vegetation that poses a threat to the safe and reliable operation of the power line. These threats include trees that could grow-in, fall-in, or blow into the power line. Utilities manage vegetation in a cost effective and environmentally conscientious manner, and within the stipulations outlined in permits, grants, and easement documents. Vegetation management may occur either as routine maintenance of existing power line corridors, or as part of work required to build new power lines in new rights-of-way.

Some utilities use the integrated vegetation management (IVM) technique to remove trees and undesirable vegetation (e.g., tall, fast growing species). The goal of IVM on utility rights-of-way is to establish sustainable stable, low-growing plant communities that are compatible with power lines and discourage undesirable tall vegetation that could pose potential safety, access, fuel load, or reliability problems. IVM requires a combination of manual, mechanical and herbicide control methods. Equipment and materials will vary with each control method selected and site-specific conditions. Utilities require access along the entire power line ROW when conducting vegetation management. Where removal of tall trees and vegetation or "danger trees" is required along a ROW it is unlikely to be within designated greater sage-grouse habitat or cause adverse impacts. Additional timing or seasonal restrictions may be considered when conducting this work and that requires travel through designated greater sage-grouse habitat.

Comment [SL12]: Move this to BMP section?

With proper IVM, the low-growing vegetation can eventually dominate the right-of-way, inhibit tall-growing vegetation or incompatible species and reduce the need for future treatments. Establishing native vegetation will also reduce the invasion of noxious weeds into the corridor , and can help reduce the risk of fire

IVM techniques include but are not limited to:

- Manual and mechanical cutting, where wood debris is left on site to enrich the soil. Hand-operated power tools (chainsaws), mechanical equipment, and hand tools are used to cut, clear, or prune herbaceous and woody target species.
- Cover type conversion, which uses herbicides in combination with manual/mechanical cutting to remove incompatible tall-growing trees and other

vegetation from the right-of-way in order to establish a stable, low-growing plant community.

Removal of trees could occur under the following circumstances.

- All fast-growing trees located directly below **distribution lines** and that could continually grow back into the lines would be removed. Tree removal would be limited to the ROW corridor and would not exceed 15 feet on either side of the wires. However removal of large hazard trees (e.g., trees that could fall onto the power line) would be required beyond this distance.
- Tree removal near **transmission lines** would vary depending on the height and voltage of the wires. A description of BMPs for tree removal on transmission lines is provided in the figure below (Bramble and Byrnes Wire Zone-Border Zone).

Comment [SL13]: Wouldn't this distance vary with voltage?

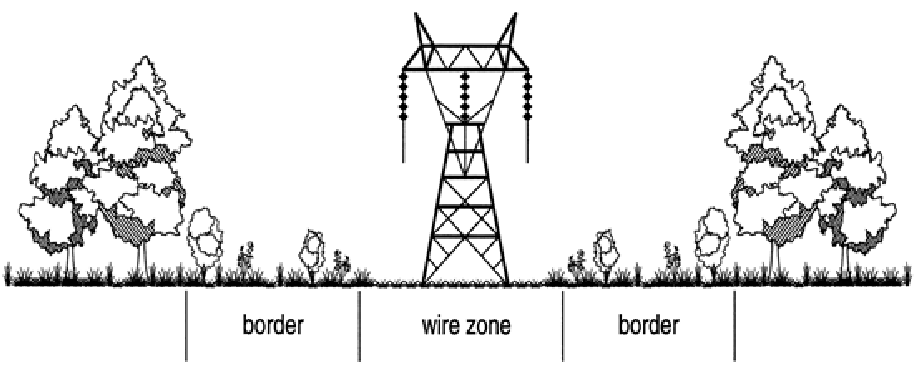

Figure 1. Bramble and Byrnes Wire Zone - Border Zone (from Yahner, Bramble and Byrnes 2000). [Source: PacifiCorp 2005:27.]

6.2.2 Major Corrective Maintenance Activities

Replacement or rebuild activities are relatively large-scale efforts that occur on an infrequent basis and may require ground disturbance activities within ~~an doutside~~ and outside of existing ROWs. Facilities may require replacement due to damage by man or nature, age of facility, or other factors. This work generally is planned and encompasses more work than defined by routine or under emergency activities. It may involve multiple structures, larger work crews, a variety of equipment, including heavy equipment, and usually take weeks or months to complete. Equipment that may be involved can include 4-wheel drive trucks, man lifts, material (flatbed) truck, bucket trucks, boom truck, tractor trailer, snow cat, excavator (back hoe or track hoe), grader, concrete truck, pumping equipment, crane, etc. Most major activities involve grading, excavation or disturbing soils, and vegetation removal or crushing. New access to or along the power line ROW may be required and timing or seasonal restrictions can be considered for work within or travel through designated greater sage-grouse habitat (see BMP section).

Major corrective activities may include conductor replacement, which may be done to increase capacity on a line or for repairs. Generally, many miles of conductor would be replaced during one project. This would require the use of staging, pulling, or lay-down areas for wire and equipment. Another example of a major corrective action could be access road improvement and/or relocation. This could involve grading and repair or installation of culverts and drains. Projects that involve multiple structure relocation or replacement would typically be considered major corrective actions. These activities would have similar footprints and durations of new construction activities within the project area.

6.2.3. Emergency Maintenance Activities

The implementation of routine operation and maintenance activities on power lines will minimize the need for most emergency repairs. Emergency maintenance activities are often those activities necessary to repair natural hazards, weather, fire, or man-caused damages to a line. Such work is required to eliminate a human health or safety hazard, prevent imminent damage to the power line, or to restore service promptly in the event of an outage. In the event of an emergency, a utility must respond as quickly as possible to restore power and may be required to take actions beyond those authorized in its ROW grant. This may include construction of new access routes or reworking access roads without prior review or approvalsIn most cases, notification of a land manager or resource agency of the emergency and actions taken should be done in concurrence with the utility responding to the emergency. Reasonable efforts should be taken during emergency response to reduce potential impacts to greater sage-grouse or their habitat in designated areas. The utility and resource agencies can work together to identify and implement appropriate restoration or remedial measures after the emergency has been addressed.
NERC defines an emergency as:

"TO BE ADDED." *A condition or situation that is imminently likely to endanger life or property or that is imminently likely to cause a material adverse effect on security of, or damage to utility's electrical system and/or flow of electricity.*

The equipment necessary to carry out emergency repairs is similar to that necessary to conduct routine maintenance, in most cases. Emergency response to outages may require additional equipment to complete the repairs.

[add para on problem nest management from Suggested Practices, or reference it]

Comment [SL14]: See prior comment re this (per Diana L).

Comment [EH15]: This is a recommendation document so thought maybe we should use "should" or is "highly recommended" throughout the document?
Per Diana Leikert

Comment [EH16]: Can we include the NERC definition if one is available so we can be consistent with industry standards? I can research….
Per Diana Leikert

d. Fires

a) Assess risk to human health and potential fire occurrence

b) Assess and identify impacts if fire occurs

c) Communicate with land management agencies to conduct rehabilitation on a case-by-case basis post fire

Comment [SL17]: Move to BMP section, or has this been covered already?

Table 1. Examples of Routine Maintenance Activities*

Activity	Description	Equipment	Frequency/Duration
Aerial Inspection	Visual inspection of lines and poles to detect any problems	Helicopter {or fixed wing aircraft?}	Annual or semi-annual/Day(s) for a line, minutes or less for each structure
Access Road Maintenance	Removal of road access obstructions	4wd truck back hoe	As needed/Day(s)
Guy Wire Tightening	Tightening guy wires	Bucket truck or boom truck	As needed/Days
Problem Bird Nest Management	Addressing bird nests that pose a fire threat, hazard to the bird or potential power outage. Actions may include nest removal or relocation, nest platform installation, and/or pole modifications to discourage re-nesting**	Bucket truck or boom truck	When problem nests are identified/Day(s)
Crossarm Replacement	Installing new crossarm on pole	bucket truck or boom truck	As needed/Day(s)
Crossarm Reframing	Lowering crossarms to obtain avian-safe separations***	bucket truck or boom truck	As necessary/Day(s)
Ground Inspection	Visual and physical inspection of lines and poles to detect any problems	ATV 4wd truck	Semi-annual or annual/Day(s)
Hardware Tightening	Tighten existing hardware on structures	boom truck or bucket truck	As needed/Day(s)
Insulator Replacement or Conductor Repair	Replacement of an insulator upon failure or repair of a broken conductor	bucket truck or boom truck	As needed/Day(s)
Installing Bird Protection Measures	Installing protective covers, line markers or other devices intended to minimize electrocutions or collisions	bucket truck or boom truck	When problem structures are identified/Day(s)
Pole Testing and Treatment	Take core samples from poles and treat poles with chemical preservative	ATV 4wd truck	10-16 year cycle/Day(s) to week(
Pole Replacement	Individual pole replacement in same location	bucket truck or boom truck	When problem structures are identified/Day(s)
Vegetation Management	Clearing of undesirable vegetation and danger trees from ROW and hazard trees that are within the ROW or adjacent to the ROW ****	ATV 4wd truck bucket truck chainsaws mower or sprayer	3-4-year cycle for distribution lines/Day(s) to week(s) 3-10 year cycle for transmission

Comment [SL18]: Cycle would differ by regions, check

Comment [SL19]: Cycle would differ by regions, check

		(herbicide use)	lines/Day(s) to week(s)

*Note: these are common examples; actual equipment, activities, frequency, and duration will vary by utility and project.
**See APLIC (2006) for more details on management of nests on utility structures and associated permitting requirements.
***See APLIC (2006 and 2012) for additional information on preventing avian electrocutions and collisions with power lines.
**** *danger and hazard trees as defined in ANSI A300*

Table 2. Major Corrective Maintenance Activities

Activity	Description/ Impact	Equipment	Frequency/Duration
Multiple Structure Relocation or Replacement	Create staging pad and pole laydown area, dig new pole holes and anchor holes, frame structures, remove old poles 2-3	4wd truck, boom truck, excavator, bulldozer or other tracked vehicle, bucket truck, helicopter or crane, material truck	As needed/Days to weeks
Anchor Replacement	Installation of new anchor 1	4wd truck, back hoe	As needed/Days
Conductor Replacement	Replacing conductor typically associated with a non-emergency pole change-out 1-2	4wd truck, boom truck, bucket truck, material truck, crane or helicopter	As needed/Days to weeks
Access Road Improvement and Relocation	Altering the alignment of any existing access routes, creating replacement access, substantial grading, installing additional culverts 2-3	4wd truck, bulldozer, grader, excavator, material truck	As needed/Days to weeks

Disturbance Impact Scale: 1- low impact, work within ROW; 2- moderate impact, work within and adjacent to ROW; 3- greater impact, some work within ROW but most work likely outside of ROW

Comment [SL20]: Need to discuss these ratings

7.0 Utility Best Management Practices in Sage-grouse Areas

Comment [SL21]: This section will be the primary focus of the face-to-face meeting.

Comment [UF&WS22]: Should include / reference / address infrastructure measures from COT Report (p 51-52)

Siting Considerations for Projects in Greater Sage Grouse Habitats

I. Power Line Planning

Route selection is a complex process that incorporates multiple factors and resource concerns, various agency objectives and regulations, and compliance with other federal requirements such as those outlined under NERC/FERC. The utility must balance impacts to both the natural and human environment and select a route that minimizes overall impacts to the greatest extent feasible. The following section outlines a process to incorporate Greater sage grouse conservation into a utilities overall planning process.

Utilities also must take take into account federal/ state energy guidelines – FERC and NERC reliability standards

i. Transmission and Distribution Line Activity
   1. Data Collection and Project Planning
      a. Conduct desktop (GIS data collection) reviews to establish habitat during the early planning stages of a project.
      b. Engage state and federal agencies to collect information on sage grouse habitats in the project study area.
      c. Establish routing criteria with agency representatives to avoid impacts to sage grouse (Create appropriate buffer criteria to incorporate into macro-corridor and route refinement analysis)
      d. Macro-corridor level analysis
      e. Micrositing/Route Refinement

   2. Establishing a Route
      a. Avoid crucial sagebrush habitats
      b. Collocation with existing linear facilities, disturbances, and existing access roads

Comment [UF&WS23]: Should define this and include PACs. Also, disturbance density consideration should be mentioned. In some states (and BLM RMPs within states), disturbance caps are or will soon be in place.

c. Route selection should seek to avoid sage-grouse buffers whenever feasible to minimize both construction and maintenance related impacts.

i. Use of existing roads where feasible
ii. Identify access roads and micro site in low quality habitat even if this results in a longer road
iii. Multi-purpose road use for construction and maintenance
iv. Site staging areas outside of sagebrush habitat, where allowable
v. If vegetation removal is needed, cut rather than mow, so vegetation root mass is maintained
vi. If vegetation road clearing is needed, perform prior to nesting season

II. Buffers
   a. Seasonal and Spatial
   b. Reference Plans
   c. Bird monitors (i.e. nesting season); pre-construction surveys

III. Traffic Management
   a. Regulated time of day restrictions
   b. Speed limits
   c. Drive and crush: use of mats to conserve sagebrush how do we minimize impacts to avoid damage to sagebrush and keep operations feasible?
   d. Avoid driving in muddy areas, creating ruts

IV. Weed Control
   a. During construction
   b. Cleaning vehicles

V. Reclamation
   a. Local seed bank seeds appropriate for habitat
   b. Mixes in agricultural areas and right of ways; may need to work with counties to use a seed mix beneficial to sage-grouse
   c. Native seed is not always used

Sage-grouse susceptibility to vehicle collisions, due to use of roads for lekking. Drive carefully on dirt and gravel roads in potential sage-grouse habitat march-april in early morning and late evening. Esp. near dithes along roads in dry years.

Comment [UF&WS24]: Goal should be to adhere to buffers and avoid disturbance within them. "Avoid buffers" could be confusing.

Comment [UF&WS25]: And utility corridors

Comment [UF&WS26]: Suggest steering first to non- or unsuitable habitat, then low-quality habitat

Comment [UF&WS27]: Unclear what this means – why would this not be allowed?

Comment [UF&WS28]: Aren't cutting and mowing the same thing in grassland? Suggest cutting rather than grubbing, or something similar.

Comment [UF&WS29]: Suggest "outside of"

Comment [UF&WS30]: Important to distinguish that the primary goal should be to avoid impacts to nesting and nesting habitat where possible / feasible through siting (e.g., larger lek buffers [4 mi commonly cited]) – secondary goal is avoidance of disturbance to lek activity.

Comment [UF&WS31]: Don't know what this means – just that buffers are shown on the plans?

Comment [UF&WS32]: What about compensatory mitigation (offsets) for unavoidable losses? This should be included.

Comment [UF&WS33]: And states

Determining Suitablility of Habitat

Habitat requirements for sage-grouse typically include areas with groundcover of grass and forbs with a shrub layer, and lack of large overstory trees, common in sage brush/shrub-steppe habitat. Sage brush provides cover and winter forage important to sage-grouse.

Active lek: any lek active within the last 24 months.

- Breeding period – March 1 – June 15 (WA).
    - Leks- March-April (early morning/late evening)
    - Nests- mid-April-June
- Avoid potentially disturbing activities (causing birds to flush for a substantial length of time) near leks (approx. 2km) between 1800 and 900 hours, February through April
- Limit construction activities within 1 km of breeding habitat February-June
- Activity that creates continuous noise during lekking season should occur outside a 3 km buffer.
- Use existing roads and rights-of-way whenever possible
- Minimize removal of sage brush
-

Definition of suitable habitat
When to conduct surveys
Summary of life history
Definition of lekking/nesting seasons
Physical buffers for leks & nests (depends on equipment, duration of work, normal human activity in area, topography, etc.)
Timing parameters for leks & nests (depending on equipment, duration, normal human activity in area, topography, etc.)
When to use biological monitors to detect disturbance

I. Perching and Nesting Issue

Background –nesting and perching of raptors and corvids on utility power lines and other tall infrastructure in sagebrush steppe habitats occupied by Greater sage-grouse has been perceived as a significant threat to sage-grouse due to the likelihood of increased predation on both adults and young. These predation effects are not well understood nor have there been many scientific studies conducted that have documented this threat in the scientific literature?.

Comment [UF&WS34]: Based on what literature?

Comment [UF&WS35]: Based on what literature?

Comment [UF&WS36]: Based on what literature?

Underground power lines – is a mitigation measure often recommended or considered to eliminate or reduce tall structures in sage-grouse habitat

- Burying high voltage power lines poses many issues, and is not always feasible. Many factors should be included in the decision process. Power companies are expected to provide immediate and reliable power to customers at the lowest cost possible, and undergrounding can contribute to longer outages and more expensive service that will affect customers. Terrain, habitat type, existing infrastructure or natural features, maintenance access, reliability and construction constraints or other factors are considerations that needs to be evaluated prior to proposing to construct an underground line.
- Characteristics of the line including voltage and type of cable, land use patterns, soil conditions, regulatory acceptance, outage risk and reliability requirements, length and operating limits may make it feasible, or not to bury.
- The ground disturbance is greater for underground lines than overhead lines of the same voltage. The need for trenching and additional ground disturbance of native vegetation may led to introduction of invasive plants and noxious weeds, soil compaction and other factors that impact the native vegetation along the ROW.

Perch Discouragers – is another mitigation measure recommended to prevent perching or nesting of corvids and raptors on distribution poles and high voltage transmission line structures.

As research has shown perch discouragers are not successful in preventing corvids, raptors and other birds from perching on wires and very limited in keeping birds off structures. The purpose and intent of using these devices was to reduce bird electrocutions by moving a bird wanting to perch in an unsafe location to a safe perching location on a structure. They were not intended to "prevent" perching. Perch discouragers have also allowed some corvids and other raptors to build nests in locations on the structure not previously occupied due to their design and this can expand the range of corvids.

Recommended practices or related stipulations from sage-grouse conservation plans that may not be feasible or recommended to reduce nesting or perching of raptors or corvids on new lines.

Vegetation Management BMPs

Vegetative species important to sage-grouse

Compatibility of sage-grouse habitat with vegetation management objectives in power line corridors

Protection of sage brush/shrub-steppe habitat whenever possible

Caution when entering ROW – concern for sage-grouse vehicle collisions or lekking behavior on dirt/gravel roads or in actual ROW

Comment [EH37]: Once we start adding text to this section, it would be good to include the financial comparison of overhead vs underground as well as the relative environmental costs of burying a high voltage transmission line in sensitive habitat for grouse or other species. Maybe include information on sagebrush restoration and how difficult this could be on a long linear corridor?
Per Diana Leikert

Comment [EH38]: Include photos and research of APLIC members in this section as we move forward?
Per Diana Leikert

Comment [UF&WS39]: Unsure what this is supposed to be – a heading for an eventual list of previously recommended but infeasible measures?

Sage-grouse sensitivity to noise disturbance (existing level of noise – site specific), equipment, duration and proximity of activities
Buffers for different types of activities – also depend on time of day and topography (line of sight/noise buffers)
Chemical treatment may have a negative effect on wintering, breeding, nesting, and brood-rearing sage-grouse (WA Sage-grouse Recovery Plan, p 52-53).
When to use on site biological monitors to determine level of disturbance

Chemical treatment may have a negative effect on wintering, breeding, nesting, and brood-rearing sage-grouse (WA Sage-grouse Recovery Plan, p 52-53).

Vegetation Management Outline from working group

I. Management for access production and reliability

- a. Tree trimming for new projects and existing poles
  - i. Tree maintenance for new construction, and possible removal
  - ii. Reliability standards for keeping a clear corridor
- b. Vegetation trimming
  - i. Mowing, only tops of woody vegetation
  - ii. Access to construction site, and clearing for operations and maintenance
  - iii. Fire suppression to reduce imminent danger
  - iv. Providing quality habitat for sage-grouse and safety for human health

II. Prevention of Unwanted Plant Species and Control of Vegetated Areas

- a. Herbicide when sage-grouse would not be negatively impacted
- b. Invasive weed control through minimal construction impact

III. Strategies to Prevent Habitat Fragmentation

- a. Reclamation of access roads, limiting herbicide use, reducing the footprint
- b. Vehicle inspection to reduce spread of invasive weeds
- c. Reseeding when necessary and applicable after construction
- d. Other habitat rehabilitation

Mitigation

I. Triggers for the processes of the where, when and what to address mitigation
- a. NEPA process
- b. Unavoidable impacts

II. Mitigation Tool Box
- a. Grazing management

Comment [UF&WS40]: There may be other triggers – compliance with state executive orders, permit / easement conditions, etc.

Comment [UF&WS41]: The big ones are missing here – habitat restoration, habitat acquisition, conservation easements, removal of unused infrastructure, etc. Also should include discussion of how to mitigate temporal impacts (mitigate in advance of impacts; increase replacement ratios, etc.)

b. Spring restoration; potential for West Nile Virus: running water versus ponds
c. Construction easements

Comment [UF&WS42]: How is this mitigation?

d. Genetically modified sagebrush seeds to increase growth. Is this an option for future management? Sagebrush is difficult to grow
e. Washington State University is working with fungus (black fingers of death) to remove cheat grass. The fungus helps to inhibit cheat grass, and encourages natives to grow. FWS is in process of licensing with EPA
f. Fence removal and marking
g. SGI, Equipment, WHIP
h. Fire suppression, fire management, and green stripping

III. Funding

a. Need for agency consensus for funding research as mitigation
b. Efforts from WAFWA
c. Feathering right of way edges

IV. Restoration and Strategy

Comment [UF&WS43]: Why isn't this included in the mitigation toolbox?

a. Habitat restoration and improvements for sage-grouse on co-owned lands

Comment [UF&WS44]: What does this mean, and why is co-ownership a requirement?

b. Mitigation banking
  i. FWS is exploring this intensively
  ii. Use for other species
  iii. Current problems include staffing
  iv. Partnerships would be beneficial

12.0 Research - (to be revised)

Comment [UF&WS45]: Should add Knick et al (2013) and cite effects associated with disturbance % and powerline densities, etc.

Electromagnetic Fields – (remove??)

Naugle et al. (2010) raised the concern that sage-grouse may also avoid transmission lines because "electromagnetic radiation emitted from transmission lines has a variety of negative effects on other bird species using areas on or near lines (Fernie and Reynolds 2005). Balmori (2005, 2006), Balmori and Hallberg (2007), and Everaert and Bauwens (2007) suggested possible cause-effect relationships between high levels of electromagnetic radiation within 500 m of cellular towers and reduced population or reproductive performance of a limited number of bird and amphibian species. These negative effects are similar to those documented for bird species exposed to electromagnetic radiation generated by power lines (Fernie and Reynolds2005).

iii. Falcon to Gondor (University of Nevada) – a ten year research study was recently completed on a high voltage transmission line to assess direct impacts to sage-grouse in northern Nevada.

- A correlation was found between annual pre-fledgling chicks survival estimates and spring climate conditions, with high accumulated spring precipitation
- Predation was the major source of mortality, and accounted for 89% of all mortalities identified during the study. During the nesting season, mortality by raptor and mammal predation was relatively equal, resulting in cumulative risks of 0.10 and 0.08, respectively. In the fall, the cumulative risk of mammal predation was greater than that of raptors or human harvest. During both seasons observations showed relatively few additional sources of mortality (e.g. collision) and observed no instances of disease-related mortality (e.g. West Nile Virus).
- In the pre-fledging chick survival analyses, distance from the Falcon-Gondor transmission line was supported in model results and the parameter estimate was significant. However, the negative influence of distance from the Falcon-Gondor transmission line suggests that early chick survival was higher if the brood was located closer to the transmission line, which may potentially be confounded with differences in pre-fledging chick survival between the Roberts and Cortez sage-grouse populations. In the female survival analyses, there was no support found for an influence of nest distance from the Falcon-Gondor transmission line on spring, fall, or annual survival. In the male survival analyses, model results supported an interaction between the amount of wildfire footprint surrounding a lek and the distance of the lek from the Falcon-Gondor transmission line on survival of males. However, this interaction suggests that annual survival for males is higher for males that attend leks closer to the transmission line. This interaction was most likely driven by extremely low survival of males at the Horse Creek lek, which had the largest amount of wildfire scarring, and, coincidentally, was located the furthest from the Falcon-Gondor transmission line. In the male lek movement analysis, we found no support for an influence of the Falcon-Gondor transmission line on male movement rates between leks.
- Transmission Line Analysis: After ten years of investigating the potential impacts from the Falcon-Gondor transmission line the results suggested no negative effects on demographic rates (i.e., male survival and movement, female survival, pre-fledging chick survival, and nest survival) that could be explained by an individual’s proximity to the transmission line.

iv. Dr. Terry Messmer at USU (telemetry and micro siting)

- In this study GIS-based viewshed analysis was used to look for evidence that sage-grouse in Utah and Southeast Idaho are avoiding powerlines based on visibility of the tall structures. His analysis is using a large database of sage-grouse locations collected from 1998-2012. Kernel density plots of observable grouse distances from powerlines did not support an avoidance hypothesis, as the occurrence frequency of visible grouse did not increase with distance from powerlines. This informal test of an avoidance hypothesis assumes that powerlines were in place when sage-grouse locations were collected, and further assumes that field collection methods were not biased with respect to proximity from powerlines locations.

v. Chad LeBeau' s Master's Thesis (wind and transmission) – study was conducted in an existing and proposed wind farm development in Wyoming to assess avoidance behavior and use of areas with wind turbines and power lines

- Greater sage-grouse did not avoid wind turbines during the nesting and brood-rearing periods, but did select for habitats closer to turbines during the summer season. Greater sage-grouse nest and brood survival decreased in habitats in close proximity to wind turbines, whereas female survival appeared not to be affected by proximity to wind turbines. Peak male lek attendance within both study areas experienced significant declines from 1 year pre development to 4 years post development; however, this decline was not attributed to the presence of the wind energy facility.
- Greater sage-grouse were not avoiding the wind energy development two years following construction and operation of the wind energy facility. This is likely related to high site fidelity inherent in sage-grouse. In addition, more suitable habitat may exist closer to turbines at Seven Mile Hill, which may also be driving selection. Fitness parameters including nest and brood survival were reduced in habitats of close proximity to wind turbines and may be the result of increased predation and edge effects associated with the wind energy facility. Lastly, wind energy infrastructure appears not to be affecting male lek attendance 4 years post development; however, time lags are characteristic in greater sage-grouse populations, which may result in impacts not being quantified until 2–10 years following development.
- Future wind energy developments should identify greater sage-grouse nest and brood-rearing habitats prior to project development to account for the decreased survival in habitats of close proximity to wind turbines. More than 2 years of occurrence data and more than 4 years of male lek attendance data may be necessary to account for the strong site fidelity and time lags present in greater sage-grouse populations. Knick and Hansen (modeling effort, sage-grouse persistence relative to anthropogenic features)

vi. Seasonal Activities (taken from *Greater Sage-Grouse* Knick, and Connelly)

- Movement of Sage-grouse, according to Connelly et. al. can be placed into several categories: dispersal from place of hatching to place of breeding or attempted breeding, movements of individuals within a season, migration between distinct and, spatially separated seasonal ranges, home ranges that sum all movement types seasonally or annually: movements to obtain food, visit loafing or roosting sites, and engage in breeding behavior as well as migrations. Migrations have been defined as grouse moving >10km between seasonal ranges.
- Some grouse have use areas that are distinct for winter, breeding and summer ranges, and others utilize the same location throughout the year. Sage-grouse

may migrate between two to three differing sites, or may not migrate at all (Connelly et al. 2011).

  - Grouse that are not migrating may move > 10km throughout the year, or migratory sage-grouse may move up to 100 km.
  - Autumn migration peaks in mid-October and extends into late November. Spring migration occurs mid-February to mid-March, and summer migration in late May through early August. Migration may be initiated by weather and migration speeds and distance can vary and these variations are not readily understood.
  - In Colorado, Washington and Wyoming it was indicated that unsuccessful females moved farther between consecutive nests more so than successful females, but didn't display this behavior in the Dakotas. And longer distances between nests did not account for successful rearing

- Avoid potentially disturbing activities (causing birds to flush for a substantial length of time) near leks (approx. 2km) between 1800 and 900 hours, February through April
- Limit construction activities within 1 km of breeding habitat February-June
- Activity that creates continuous noise during lekking season should occur outside a 3 km buffer.
- Use existing roads and rights-of-way whenever possible
- Minimize removal of sage brush
- Physical buffers for leks & nests (depends on equipment, duration of work, normal human activity in area, topography, etc.)
- Timing parameters for leks & nests (depending on equipment, duration, normal human activity in area, topography, etc.)
- When to use biological monitors to detect disturbance

11.0 Specific Agency Permit Restrictions or Conditions – (added as required)

13.0 Incorporating Greater Sage-grouse Into Company Environmental Training Programs:

- **T&D Projects — Environmental Checklist (add examples)**
- **Development of GIS Databases and Maps to Ensure Maintenance Staff area aware of when they are working in sage-grouse habitat**
- **Others….**

GLOSSARY

Include selected terms from other APLIC manuals