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

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*To be added*

## 2.1 What is APLIC?

The Avian Power Line Interaction Committee (APLIC) was formed in 1989 as a collaborative effort among electric utilities, resource agencies, and conservation organizations to address whooping crane collisions with power lines. Since its inception, APLIC has expanded to address a variety of avian/power line interactions including electrocutions, collisions, nests, and avian concerns associated with construction of new transmission infrastructure.

Current APLIC membership includes electric utilities, Edison Electric Institute (EEI), Electric Power Research Institute (EPRI), National Rural Electric Cooperative Association (NRECA), Rural Utilities Service (RUS), and the U.S. Fish and Wildlife Service (USFWS). For more information about APLIC and upcoming workshops, see www.aplic.org. APLIC's mission is to lead the electric utility industry in protecting avian resources while enhancing reliable energy delivery. APLIC works in partnership with utilities, resources agencies and the public to:

- Develop and provide educational resources
- Identify and fund research
- Develop and provide cost-effective management options, and
- Serve as the focal point for avian interaction utility issues

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 jointly released the *Avian Protection Plan Guidelines*, which offer a "toolbox" for utilities to address avian issues. In addition, APLIC offers 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 are committed to operating and maintaining their infrastructure to deliver safe and reliable power in ways that minimize environmental impacts, particularly in regards to birds, and other wildlife, and their habitats.

## 3.0 Introduction and Purpose

Increasing demands for electricity and the development of renewable energy projects require construction of new power lines and upgrades of existing infrastructure to transmit electricity from where it is generated, which is often in remote areas, to more populated load centers or new customers. Wildlife scientists and public land managers have expressed concerns that these new and existing, transmission and distribution structures ("tall structures") may impact sage-grouse[1] and their habitat. Siting guidelines and stipulations for utility infrastructure in sage-grouse areas vary between state and federal agencies, as well as among different offices at the local level within the same federal agency. The effectiveness of these siting guidelines and stipulations such as lek buffer distances (avoidance areas) and seasonal construction or maintenance restrictions have not been adequately evaluated to date (Messmer et al. 2013).

In response to sage-grouse/ power line concerns and the uncertainties related to siting and permitting new lines and variability of associated avoidance and minimization guidance. APLIC convened a collaborative of utility and agency partners to develop BMPs that could aid in addressing the issue. Consequently, APLIC and its federal and state agency partners have prepared a suite of best management practices (BMPs), contained herein, for the purposes of:

- Assisting electric utilities to minimize impacts to sage-grouse and their habitats, which may result from the construction and maintenance of new or existing electrical facilities on federal, state, and private lands;
- Providing a clearinghouse document that is specific to electric utility activities, how these actions may impact sage-grouse or their habitats, and BMPs targeted specifically to these activities.
- Maintaining a "living document" that can be referenced in other documents (e.g. state sage-grouse plans, Bureau of Land Management (BLM) and U.S. Forest Service (USFS) planning documents, utility rights-of-way (ROW) grants, etc.) and would be updated to reflect the current best science.

The BMPs presented and discussed herein are intended to provide consistent and implementable actions that comply with and augment sage-grouse specific measures, recommendations and requirements contained within federal and state management plans. These BMPs are not intended to replace or conflict with existing agency plans, but rather provide additional detail specific to electric transmission and distribution infrastructure. APLIC encourages use and reference of these BMPs during permitting and re-permitting of electric facilities in conjunction with state and federal sage-grouse plans as well as APLIC's other avian protection guidance documents:

- *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (*APLIC 2006*);*

[1] Throughout this document, the term "sage-grouse" is used to collectively refer to both Greater Sage-grouse (*Centrocercus urophasianus*) and Gunnison Sage-grouse (*Centrocercus minimus*).

- *Reducing Bird Collisions with Power Lines: The State of the Art in 2012* (APLIC 2012); and
- *Avian Protection Plan Guidelines* (APLIC and USFWS 2005).

These sage-grouse BMPs and the above referenced APLIC documents can serve as a "toolbox" from which a utility may select and tailor components applicable to its specific needs. APLIC further encourages utilities that operate in sage-grouse habitat to directly reference or incorporate these BMPs into their internal company procedures, or utility Avian Protection Plans (APP).

The layout of this document is two-part:

- Sections 4 through 6 provide background information regarding electric utility construction, operations, and the regulatory framework under which utilities operate. These sections establish the context in which the identified BMPs may be implemented; and
- Sections 7 through 9 present a summary of recommended BMPs for use in siting, permitting, constructing, operating, and maintaining new and existing power lines and associated infrastructure (e.g., access roads) to minimize impacts to sage-grouse and their habitat.

### 3.1 Document Revisions

This document is a "living document" and may be updated or revised as needed to reflect new science, techniques, resources, or regulatory requirements. APLIC members and agency partners would collaborate on future document updates and revisions. Utilities and agencies that implement the BMPs contained within this document are encouraged to evaluate the BMP effectiveness and communicate this information to APLIC, resource agencies, and utilities thereby providing valuable information for future revisions of this document. BMP implementation and effectiveness will be an ongoing discussion topic within the APLIC sage-grouse working group.

## 4.0 Background of Sage-grouse/Power Line Efforts

In 2010, the USFWS placed Greater Sage-grouse on the list of species that are candidates for protection under the Endangered Species Act (ESA). One reason cited for the decision was the lack of adequate regulatory mechanisms to protect sage-grouse. Infrastructure development, including power lines, is believed to indirectly impact sage-grouse through avoidance behavior, increased avian predation and habitat fragmentation, however further research is needed to determine if these perceived impacts are occurring and contributing to sage-grouse population declines (UWIN 2010).

Prior to the USFWS 2010 decision, the Western Association of Fish and Wildlife Agencies (WAFWA) convened a diverse group of stakeholders to identify problems and strategies to conserve sage-grouse. This forum developed the *Greater Sage-grouse Comprehensive Conservation Strategy* (2006) (Strategy), and in that Strategy 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*.

Achieving these goals and implementing the resulting BMPs would provide the USFWS with additional information for consideration in their review of the current status and threat assessment of sage-grouse. APLIC's participating members and other entities recognized the need and value in accomplishing the WAFWA identified goals. Therefore, under the direction and support of WAFWA and its 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, *Contemporary Knowledge and Research Needs Regarding the Potential Effects of Tall Structures on Sage-grouse (Centrocercus urophasianus and C. minimus* [www.utahcbcp.org], **Goal 1** was addressed. The document reported that no peer-reviewed, experimental studies either confirmed or denied perceived avoidance, fragmentation, or predation effects of tall structures on sage-grouse and that additional research is required to effectively evaluate/ascertain potential impacts.

Following the above publication, UWIN hosted a working seminar attended by sage-grouse researchers, statisticians, wildlife biologists, public and private land managers, and energy representatives to develop a study design protocol. Consequently, *Protocol for Investigating the Effects of Tall Structures on Sage-grouse (Centrocercus spp.) within Designated or Proposed Energy Corridors* was published in July 2011 (www.utahcbcp.org) . The Protocol is designed to assess impacts on sage-grouse from tall structures, particularly high voltage power lines, thereby accomplishing **Goal 2**. The Protocol recommends rigorous, replicated research based on a "Before-After-Control-Impact" (BACI) study approach to address three specific research questions:

1. *Do sage-grouse avoid tall structures and if so, why?*

2. *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?*

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

On September 13, 2011, WAFWA's EOC adopted the Protocol as a study design for researching the impacts of electric transmission and distribution lines on sage-grouse populations and habitat (See Appendix B). Further, WAFWA's EOC adopted a series of recommendations from the Range-wide Interagency Sage-grouse Conservation Team (RISCT) regarding participation in the studies, determining study sites and funding research opportunities by using a portion of an authorized project's "unknown impacts" sage-grouse compensatory 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 voluntary interim BMPs was identified by the electric utility industry through APLIC. In October 2012, APLIC convened a sage-grouse/power line meeting and invited representatives from electric utilities, environmental organizations, academia, state and federal agencies, and other interested stakeholders. The group agreed there was a need for utility BMPs and committed to develop them. This document is a result of this effort among participating utilities and agencies.

## 4.1 Regulatory Framework

The following provides a brief overview of some of the federal and state legislative and regulatory compliance items applicable to electrical utilities that have been considered in the development of this document.

### 4.1.1 Utility Operational and Reliability Requirements

The goal of electrical utilities is to provide their customers with a reliable supply of electricity while maintaining the overall integrity of the regional electrical grid. Utilities' obligation to maintain reliable operation of the electrical system is directed through compliance with industry standard codes and practices. The design, operation, and maintenance of electrical facilities meet or exceed applicable criteria and requirements outlined by the Federal Energy Regulatory

Commission (FERC), Western Electricity Coordinating Council (WECC), National Electrical Safety Code (NESC), and the U.S. Department of Labor Occupation Safety and Health Administration (OSHA) standards for the safety and protection of landowners, their property, and the general public.

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 and penalties for non-compliance.

As a result of the passage of the Energy Policy Act of 2005, FERC selected the North American Electric Reliability Corporation (NERC) to act as the enforcement agency for compliance with electric utility reliability and operating standards, among other issues. Electric utilities are required to be in compliance with the various reliability standards promulgated through the implementation of the NERC policies and procedures. Additionally, electric utilities are governed by WECC standards that may be additional or more stringent than those currently required by NERC. State Public Service Commissions have also imposed inspection and corrective maintenance requirements upon utilities doing business within their states. In response, many electric utilities have prepared internal operation and maintenance policies and procedures designed to meet the requirements of NERC, WECC, and the state public utility commissions, while remaining in compliance with the applicable codes and standards with respect to maintaining the reliability of the electrical system. 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. The above regulatory requirements and others (e.g., state fire/fuels reduction programs, renewable energy mandates) may dictate utility actions that can seemingly conflict with wildlife or habitat conservation efforts. Such examples may include:

- Applying minimum separations between lines to protect against a catastrophic event (e.g., wildfire, windstorm, plane crash) versus co-locating lines within the same corridor.
- Conducting vegetation management during high fire risk periods may overlap with bird nesting seasons, particularly in high elevation areas that may not be accessible during the nonbreeding season.
- Providing required service to customers that may be located in environmentally sensitive areas.
- Constructing new transmission lines to connect new renewable generation sources (often in remote areas) to load centers in urban areas can create new infrastructure in habitats that may be otherwise undisturbed.

### 4.1.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) is a process that requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions.

The NEPA process evaluates impacts and informs agency decisions to authorize a proposed action, authorize with conditions, or deny the action. Certain changes to BLM Resource Management Plans and U.S. Forest Service Forest Management Plans may require the agency to review the environmental impacts associated with the proposed changes in management. Changes must be consistent with and compatible with authorized uses and overall agency objectives.

All actions approved or authorized by the BLM must conform to the existing Land Use Plan (LUP). The BLM LUPs are designed to provide guidance for future management actions and the development of subsequent, more detailed and limited-scope plans for resources and uses. A proposal for use or development of resources on lands administered by BLM must be determined to be in conformance with the LUP. If the proposal is in conformance with the LUP, the federal action on the proposal triggers NEPA. The BLM follows the Council on Environmental Quality (CEQ) regulations to comply with NEPA. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. Analysis and disclosure of effects of a proposed action and its alternatives are the underlying NEPA principles and these environmental analysis documents must be made available to the public.

The NEPA process involves many steps, some of which are iterative, and includes identification of design features (standard operating procedures, stipulations, and best management practices) as well as potential mitigation measures to reduce or avoid adverse impacts. The direct, indirect and cumulative impacts of the proposed action and alternatives are analyzed and the process results in a decision. Implementation of an action, including any mitigation and monitoring measures adopted, must be in accordance with the decision.

### 4.1.3 Endangered Species Act

The Endangered Species Act (ESA) (16 U.S.C. 1531-1544) was passed by Congress in 1973 to protect our nation's native plants and animals that were in danger of becoming extinct and to conserve their habitats. Federal agencies are directed to use their authority to conserve listed species, as well as "candidate" species, and to ensure that their actions do not jeopardize the existence of these species. The law is administered by two agencies, (1) the USFWS and (2) the Commerce Department's National Marine Fisheries Service (NMFS). The USFWS has primary responsibility for terrestrial and freshwater organisms, while the NMFS has primary responsibility for marine life. These two agencies work with other agencies to plan or modify federal projects to minimize impacts on listed species and their habitats. Protection is also achieved through partnerships with the states, with federal financial assistance, and a system of incentives that encourage state participation. The USFWS also works with private landowners by providing financial and technical land management assistance for the benefit of listed and other protected species. For more information on ESA, see http://www.fws.gov/laws/lawsdigest/esact.html.

### 4.1.4 Bald and Golden Eagle Protection Act

Under the authority of the Bald and Golden Eagle Protection Act of 1940 (BGEPA) (16 U.S.C. 668-668d) which is administered by the USFWS, bald (*Haliaeetus leucocephalus*) and golden (*Aquila chrysaetos*) eagles are afforded additional legal protection. *Take* under BGEPA is prohibited unless permitted, and defined as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb". For more information on BGEPA, see http://www.fws.gov/laws/lawsdigest/baldegl.html.

#### 4.1.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. 703-712), which is administered by USFWS, is the legal cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide international protection for migratory birds. It is a strict liability statute meaning that proof of intent is not required in the prosecution of a "*taking*" violation. Most actions that result in *taking* or possessing (permanently or temporarily) a protected species can be violations.

The MBTA states: "Unless and except as permitted by regulations… it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, kill… posses, offer for sale, sell…purchase…ship, export, import…transport or cause to be transported…any migratory bird, any part, nest, eggs, of any such bird, or any product… composed in whole or in part, of any such bird or any part, nest, or egg thereof…"

A 1972 amendment to the MBTA provided legal protection to birds of prey (e.g. eagles, hawks, falcons, owls) and corvids (e.g. crows, ravens). The MBTA currently protects 1,026 migratory bird species, including waterfowl, shorebirds, seabirds, wading birds, raptors and songbirds. Generally speaking, the MBTA protects all birds native to North America, and excludes house sparrows (P*asser domesticus*), European starlings (*Sturnus vulgaris*), rock doves (*Columba livia*), any other species published in the Federal Register, and non-migratory upland game birds. For more information on MBTA, see http://www.fws.gov/laws/lawsdigest/migtrea.html.

### 4.2 Overview of Power Line Infrastructure and Terminology

Power lines are rated and categorized, in part, by the voltage levels to which they are energized. Because the magnitudes of voltage used by the power industry are large, voltage is often specified with the unit of kilovolt (kV) where 1 kV is equal to 1,000 volts (v). Generally, from the point of origin to the end of an electric system, line voltage is used to designate four classes or types of power line (see Figure 1). In addition to the voltage level, power line classification is dependent on the purpose the line serves (see Figure 2). See Appendix C for example photos of different power line configurations.

A power line's voltage, configuration, conductor design and spacing, location, and structure type are determined by the present and anticipated power demands or load requirements the line will serve. If enough power/capacity is available in an area, a distribution line may be necessary; however if more energy is needed, a transmission line may be required to meet higher capacity and bring power to the load center along a greater distance. Siting of new transmission line corridors and ROWs must consider existing biological, cultural, visual, land use, land management or regulatory agency guidelines, and other aspects. When siting a new power line, utility companies must consider these environmental aspects as well as engineering, reliability and redundancy factors to determine the best route.

**Figure 1. Schematic of power system from generation to customer (from APLIC 2006).**

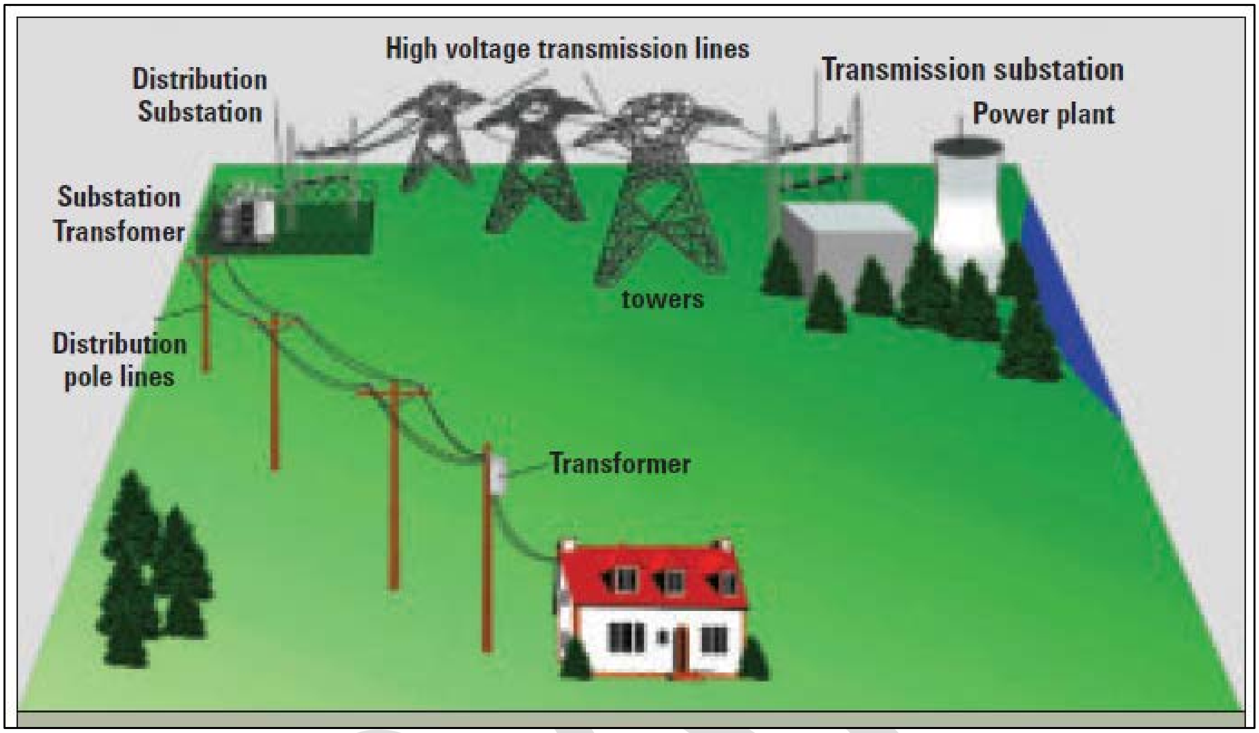



**Figure 2. Voltage ranges of different power line classes (from APLIC 2006).**

| Designation | Voltage Range |
|---|---|
| Generation plant | 12 V to 22 kV |
| Transmission | 60 kV to 700+ kV |
| Distribution | 2.4 kV to 60 kV |
| Utilization | 120 V to 600 V |

Different ROW widths are required for different power line voltage ratings; these are generally determined by state statues and the National Electrical Saftey Code. ROW widths are also a function of the structure design, span length, conductor to ground clearances, and the constructor sag. Typical ROW widths for transmission lines vary from 50 feet to more than 250 feet. Because ROWs are becoming increasingly difficult to obtain, it is a common practice to increase voltage levels of lines in exising ROWs when engineering and safety considerations allow.

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. See Appendix A for a more detailed discussion of underground power line considerations.

**4.3 Siting and Routing Considerations**

Siting and preparation for routing new transmission and distribution lines requires an open and comprehensive process that balances various factors including electric (power) system planning, the natural, human, and cultural environment, public involvement, local, state, and federal regulatory requirements such as those outlined under NERC/FERC, and resource objectives, land rights, land use, economics and engineering. The utility must select a route that minimizes overall impacts to the greatest extent feasible while still complying with federal reliability requirements, resource agency objectives, environmental regulations, landowner concerns and reducing financial liabilities and costs to ratepayers.

Specific requirements depend on location, voltage, and length of the power line. There are times when no environmental regulatory requirements may apply to power line siting. Generally, this occurs if the power line being sited involves lower voltages, short span additions, or private lands. There is a potential that power lines could be sited within sage-grouse habitat, but outside designated areas of priority conservation for sage-grouse that do not require conservation measures. These may be opportunity areas for use of BMPs contained in this document. Ultimately, utilities will follow the federal, state and local siting requirements and consultation processes, as applicable, for siting power lines to minimize impacts to sage-grouse.

## 5.0 Utility Construction Activities

Construction of power lines is a sequenced and planned process with timing goals, specific construction practices, and proactive measures to reduce power line footprints on the ecological landscape. Depending on the type of line being constructed, there are several different construction practices that a utility undertakes. For a video demonstrating transmission line construction, see [add link to GWW video/website].

When building a power line, a typical construction sequence begins with building access roads as needed, throughout the corridor to construct the power line and set the stage to conduct maintenance during the life of the line. Access road size generally depends on the largest piece of equipment that would travel on the road during construction. Second in the construction phase is site preparation, and constructing staging areas and substation sites, which also require access. During the processes, erosion control is minimized by installing water bars, culverts, and sediment basins in order to reduce the footprint.

Construction for power pole foundations differ, depending on the type of structure needed. Assembling high voltage structures typically involves delivery of components for each structure by a flatbed truck with assembly done onsite. As construction takes place, a crane moves along the ROW to set each structure in place, and in some cases, a helicopter may be necessary.

Construction of wood pole structures typically requires poles be embedded in the soil and does not require a foundation. Rather a hole is augured, typically to a depth equaling 10% of the overall height of the pole. Wood structures (single pole and H-frame) are framed on the ground at the structure site and set in place by a truck-mounted crane. The wood pole is placed within the hole and soils or crushed rock is backfilled around the pole.

Foundations are generally required for steel structures. Typical foundations are made of steel reinforced concrete piers. The foundation diameter and number of foundations needed for a structure vary depending upon structure type. For example, steel lattice structures require four foundations that are generally four feet in diameter and 15 feet deep, though these numbers may vary dependent on the soil or rock type at each site. Reinforced steel anchor bolt cages are installed after excavation of the foundation holes and before concrete placement to strengthen the foundation's structural integrity. Concrete foundations typically extend about two feet above the ground. Steel lattice structuresare assembled in sections using a truck-mounted crane or similar equipment, and then lifted onto the foundation using a large crane specifically designed for tower construction.

Once structures are in place, the line, or conductor, is strung. Temporary work sites are set up for the equipment used to pull and tighten the conductor. The spacing of these siting along a line depends upon the span length, size of the conductor, and length of conductor on a reel. The initial stringing begins with a helicopter pulling a lighter weight sock line through sheaves attached to each tower. A specialized wire-stringing vehicle is attached to the line to pull it through, followed by tightening or tensioning the line to achieve the correct sagging of the line between support structures.

The duration of construction varies greatly depending on several influencing factors such as access needs, ease of access, project length, and availability of construction resources. The length of the project is an important influencing factor in determining the duration of construction. In general, the longer the project the faster the project may be constructed on a per mile basis. This is because, in a typical project setting, the construction contractor utilizes more crews to construct the project, thereby facilitating faster construction on a per mile basis. Figure 3 shows examples of construction durations for typical construction of distribution, low voltage transmission, and high or extra high voltage transmission. Actual construction durations may vary from the typical durations/examples presented. In order to estimate durations on a per mile basis, typical project lengths were assumed (Project Length column of Figure 3). For example, as presented in Figure 3, a 50- mile high voltage transmission line may be constructed at a pace of 1-2 weeks per mile. In contrast, a 5 mile distribution line may be construction at 2-3 weeks per mile since fewer construction resources (construction crews) may be utilized.

**Figure 3. Example Durations for Construction of Power Lines**

| **Voltage Classification** | **Project Length** | **Structure Type** | **Terrain** | **Duration per Mile** |
|---|---|---|---|---|
| Distribution | 5 miles | Single wood pole | Flat, sagebrush | 2-3 weeks per mile |
| Low Voltage Transmission | 20 miles | Single wood pole | Flat, sagebrush | 2-2.5 weeks per mile |
| High or Extra High Voltage Transmission | 50 miles | Steel pole/lattice with foundations | Flat, sagebrush | 1-2 weeks per mile |

Equipment utilized during construction will vary depending upon the voltage class, but typically would consist of any of the following equipment: 4-wheel drive truck, material (flatbed) truck, bucket truck (low reach), boom truck (high reach), man lift, excavator, bulldozer, pulling and tensioning equipment, truck or track mounted auger, truck-mounted crane, track-mounted crane or specialized crane, helicopter, etc.

Only the area required to construct the power line in a safe and efficient manner is generally disturbed (construction footprint). In some cases, the construction footprint may be larger than the operational footprint (permanent area needed for operations). Disturbed areas around the structures and temporary work areas are restored and re-vegetated, as required by the property owner or land management agency. All practical means are used to return land to its original contour and natural drainage patterns along the right of way.

## 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- Federal Land Policy and Management Act (FLPMA) 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 not conducted without the expressed authorization of the land managing agency or private landowner unless in response to emergencies.

Most land management plans restrict the use of vehicles seasonally or under poor weather conditions 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) and/or easements. This may include construction of new access routes or improving access roads without prior review or approvals. In most cases, a land manager or landowner would be notified of the emergency and actions taken in concurrence with the utility responding to the emergency. The utility and resource agencies or landowner 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.

Field maintenance activities may include the following three categories, each of which is detailed in subsequent sections:

- Routine maintenance (inspections, corrective actions, and vegetation management) (See 6.2.1)
- Major corrective actions (See 6.2.2)
- Emergency activities (See 6.2.3)

### 6.2.1 Routine Maintenance and Inspections

Routine inspection and maintenance activities are ordinary maintenance tasks (see Figure 4) that have historically been performed and are regularly carried out on a routine basis within the bounds of the existing power line and access existing ROW authorizations. 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. If any ground disturbance takes place, it is within the construction footprint (areas previously disturbed). Because these actions are considered authorized under the existing ROW grant, they 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. Responsibly conducted routine maintenance activities have little or no potential to disturb or unduly affect resources within ROWs or access roads.

***Safety Inspection***

Utilities are required to perform safety inspections of their power lines on a cycle that can vary from multiple times per year to every few years. Inspection frequency, which is dependent on location and voltage, 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.

## Figure 4. Examples of Routine Maintenance Activities[2]

| 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 | 4-wd 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[3] | Bucket truck or boom truck | When problem nests are identified/Hours or 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[4] | Bucket truck or boom truck | As necessary/Day(s) |
| Ground Inspection | Visual and physical inspection of lines and poles to detect any problems | ATV<br>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[4] | 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,<br>4-wd truck | Day(s) to week(s)[5] |
| 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[6] from ROW and hazard trees that are within the ROW or adjacent to the ROW | ATV, 4-wd truck, bucket truck, chainsaws, mower or sprayer (herbicide use) | Day(s) to week(s) |



[2] Note: these are common examples; actual equipment, activities, frequency, and duration will vary by utility and project.

[3] See APLIC (2006) for more details on management of nests on utility structures and associated permitting requirements.

[4] See APLIC (2006 and 2012) for additional information on preventing avian electrocutions and collisions with power lines.

[5] Cycle dependent upon area. See section 6.2.1 for discussion of routine maintenance cycles.

[6] Danger and hazard trees as defined in ANSI A300.

*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 wood pole at the ground line (to determine extent of wood rot) and re-treating that portion of the wood pole if necessary. Core samples from the wood pole may also be taken, and poles may be treated with an approved 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.

*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, 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 scheduling this work in designated sage-grouse habitat (see BMP section).

*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 electric grid. 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 as emergency response to remove branches or trees fallen on power lines (e.g. during storms), 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 manage 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 to and along the entire power line ROW when conducting vegetation management.

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 occurrence of noxious or invasive weeds into the corridor, and can help reduce the risk of fire.

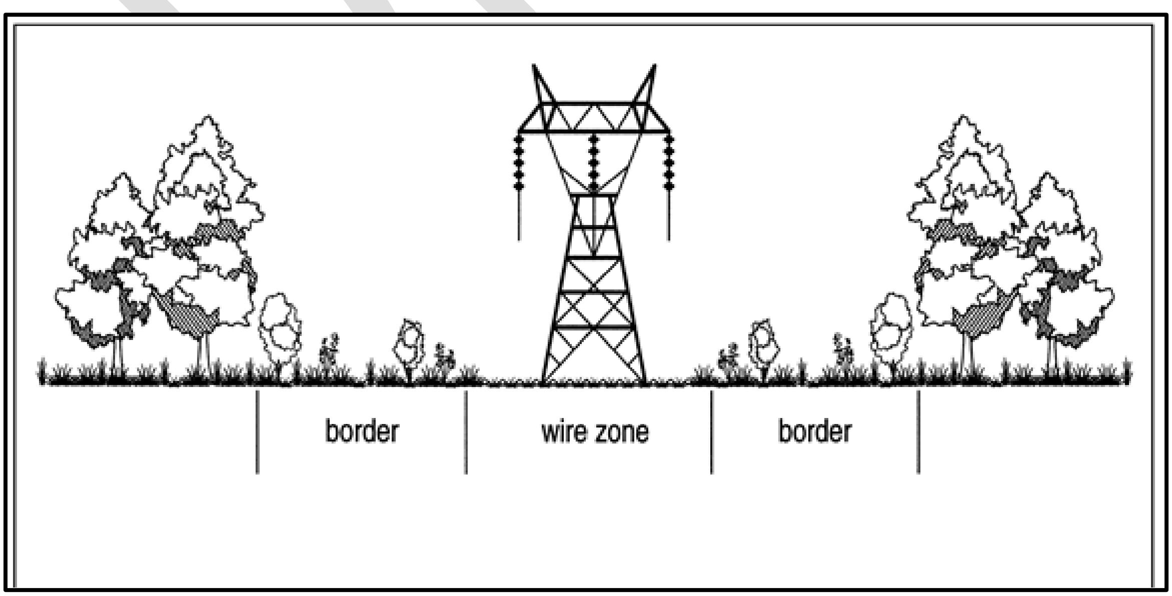
IVM techniques include but are not limited to:

- Manual and mechanical cutting, where wood debris is left on site to enrich the soil. Use of hand-operated power tools (chainsaws), mechanical equipment, and hand tools 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** that could continually grow back into the lines would be removed. Tree removal would be limited to the ROW corridor and would only extend as far as necessary on either side of the wires for removal of large hazard trees (e.g., trees that could fall onto the power line).
- Tree removal near **transmission lines** would vary depending on the height and voltage of the wires. An example of tree removal near transmission lines is provided in Figure 5 below.

**Figure 4. Example of border/wire zone using Integrated Vegetation Management.**



### 6.2.2 Major Corrective Maintenance Activities

Major corrective maintenance activities, such as replacement or rebuild activities (see Figure 6), 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 the existing ROW. Facilities may require replacement due to human- or natural-caused damages, 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.

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.

**Figure 6. Examples of Major Corrective Maintenance Activities[7]**

| Activity | Description | 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 | 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 | 4wd truck, back hoe | As needed/Days |
| Conductor Replacement | Replacing conductor typically associated with a non-emergency pole change-out | 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 | 4wd truck, bulldozer, grader, excavator, material truck | As needed/Days to weeks |

[7] Note: these are common examples; actual equipment, activities, frequency, and duration will vary by utility and project.

Most major activities involve grading, excavation or disturbing soils, and vegetation removal or crushing. Proposed actions would require site-specific environmental analysis and compliance with established permitting processes. New access to or along the power line ROW may be required and timing or seasonal restrictions can be considered for work within sage-grouse habitat (see BMP section).

### 6.2.3. Emergency Maintenance Activities

An emergency situation is 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 a utility's electrical system and/or flow of electricity. Emergency maintenance activities are those activities necessary to promptly restore electrical service or repair damage caused by natural hazards, weather, fire, problem nests, or human actions to a line or structures. 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 in the event of an outage. The equipment necessary to carry out response to outages or emergency repairs is generally similar to that used to conduct routine maintenance. At times, emergency responses may require additional equipment to complete the repairs.

The implementation of routine operation and maintenance activities on power lines will minimize the need for most emergency repairs. 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 agency review or approvals. In most cases, notification to 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 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.

## 7.0 Utility Best Management Practices in Sage-grouse Areas

Best management practices (BMPs) are specific means, measures, or practices that reduce or eliminate the potential detrimental effects of a proposed action. These measures, in some cases, are sufficient for meeting environmental policy and regulatory requirements. In some cases, additional formal and specific mitigation may be required to offset negative project impacts and ensure compliance with local, state, or federal regulations.

Resource agencies request or require that utilities first avoid crucial sage grouse habitat whenever feasible, minimize impacts if they cannot be entirely avoided, and lastly, mitigate impacts that cannot be avoided or minimized. Implementation of BMPs is an accepted method to minimize unavoidable impacts. APLIC and its agency partners have prepared this section to assist electric utilities in the identification and implementation of BMPs for avoiding and minimizing impacts to sage-grouse and their habitats during early stages of project planning through project construction and long-term maintenance activities.

The BMPs summarized below (Figure 7) are a list of voluntary environmental protection measures that can be included into a utility's project design or operational and maintenance programs to avoid and/or minimize impacts to sage-grouse and their habitats. A utility may choose to incorporate applicable BMPs into its Avian Protection Plan (APP) or other internal environmental guidance documents. These BMPs can also be incorporated into a request for the re-authorization of existing facilities on state, federal, and tribal lands.

This list of BMPs is intended to provide measures and guidance that will assist to conserve sage-grouse and their habitat. These BMPs can be applied to the siting of new power lines and associated features as well as the operational and maintenance actions associated with existing transmission and distribution lines. These BMPs are intended to address the direct and indirect impacts to sage-grouse and their habitat for new and existing power line related features on the landscape within existing sage-grouse range. The USFWS's Conservation Objectives Team (COT) Report (USFWS 2013) details potential threats to sage-grouse and their habitat. The authors of this BMP document used the COT report as a framework to identify potential threats associated with electric utility infrastructure and developed specific BMPs targeted toward minimizing these threats.

**Figure 7. Toolbox of BMPs for electric utility activities in sage-grouse areas.**

| | | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **BMP Number** | **BMP Description** | **Disturbance from Human Activities** | **Habitat Fragmentation** | **Invasive Species** | **Predation** | **Direct Mortality (Collision, Electrocution, Roadkill)** | **Fire** | **Pinyon-Juniper Encroachment** | **Habitat Loss** |
| **BMP Category: General BMPs** | | | | | | | | | |
| GEN-1 | Obtain current data on locations of sage-grouse leks, habitat, or other important areas. Each year, agencies verify the status of known sage-grouse leks. Presence will be assumed if lek surveys are not conducted to establish absence. | x | x | | | | | | x |
| GEN-2 | Identify priority habitat (e.g,, Priority Areas for Conservation (PACs), Preliminary Priority Habitat (PPH), Core habitat).<br>a. Consult state and federal plans (BLM RMPs, USFS LUPs) for existing identification/delineation.<br>b. Incorporate these maps into company GIS systems and/or for project specific documents. | x | x | x | x | x | | | x |
| GEN-3 | Avoid siting and construction in, over, and adjacent to priority habitat. | x | x | x | x | x | | x | x |
| GEN-4 | Identify and incorporate seasonal habitat(s) / ranges (consult state wildlife agency for lek locations as well as known/mapped seasonal habitat(s)).<br>a. Lek locations (consult with wildlife agency for lek locations)<br>b. Nesting and early brood-rearing locations<br>c. Winter concentration areas and/or winter ranges | x | x | x | x | x | | | x |

[8] The threats identified in this table reflect potential impacts associated with electric utility facilities in the USFWS's 2013 COT Report. Check marks in each of the threat columns indicates that the associated BMPs are targeted at eliminating or minimizing these threats.

| | | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **BMP Number** | **BMP Description** | **Disturbance from Human Activities** | **Habitat Fragmentation** | **Invasive Species** | **Predation** | **Direct Mortality (Collision, Electrocution, Roadkill)** | **Fire** | **Pinyon-Juniper Encroachment** | **Habitat Loss** |
| | d. Incorporate these maps into company GIS systems and/or for project specific documents | | | | | | | | |
| GEN-5 | Identify and incorporate physical buffers for leks & nests (depends on equipment, duration of work, normal human activity in area, topography, etc.).<br>a. Incorporate these maps into company GIS systems and/or for project specific documents. | x | x | x | x | x | x | | x |
| GEN-6 | Implement seasonal restrictions for non-emergency work.<br>a. Consult federal and state plans for site specific dates and times.<br>b. Identify appropriate avoidance periods for breeding, lekking, nesting, brood-rearing, and winter use areas; avoidance periods should include date and/or time of day restrictions appropriate to the type of activity (e.g., duration of work, amount of human activity) being conducted. | x | | | x | x | | | |
| GEN-7 | Identify and implement restrictions associated with disturbance distance buffers (consult federal and state land use plans and/or species conservation plans for buffer distances).<br>a. Identify disturbance buffers around leks.<br>b. Identify nesting habitat buffers.<br>c. Identify buffers around winter concentration areas. | x | x | x | x | | | | x |
| GEN-8 | Projects with the potential to disturb sage-grouse should be implemented in the least amount of time (while maintaining safe working practices) and during periods least likely to affect sage-grouse. | x | | | x | | | | |
| GEN-9 | Site power lines and associated facilities outside of priority sage-grouse habitat where feasible.<br>a. If facilities cannot completely avoid sage-grouse habitat, utilize micrositing to avoid important habitat features or use areas. | x | x | x | x | x | x | | x |

| BMP Number | BMP Description | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
| GEN-10 | Co-locate new structures and development in corridors within or adjacent to existing linear infrastructure corridors or other linear features, as allowed by reliability criteria and requirements. | x | x | x | x | | x | | x |
| GEN-11 | Site power lines and other utility infrastructure within existing disturbance areas where feasible. | x | x | x | x | | | | x |
| GEN-12 | Avoid and minimize vegetation disturbance/ removal in priority habitat.<br>a. Site staging areas to avoid priority habitat and minimize size of staging areas.<br>b. Minimize new development of access roads by utilizing existing roads where feasible.<br>c. Pulling locations should be placed outside of priority habitat where feasible.<br>d. Equipment storage should be placed outside of priority habitat where feasible. | x | x | x | x | | | | x |
| GEN-13 | Remove abandoned utility infrastructure and reclaim associated impacted / disturbed habitat(s). | | x | x | x | x | | | x |
| GEN-14 | Remove abandoned utility access and reclaim associated impacts / disturbed habitat(s). | | x | x | x | | | | x |
| GEN-15 | Comply with required and voluntary density disturbance caps (consult federal and state plans for existing disturbance caps). | x | x | x | x | | | | x |
| GEN-16 | Reclaim temporary project construction disturbance areas. | | x | x | x | | | | x |
| GEN-17 | Mitigate for impacts (direct and indirect) associated with development and surface disturbing activities related to the construction and maintenance of power lines. | x | x | x | x | x | | | x |
| GEN-18 | Develop and implement a utility project checklist as part of company's environmental protection measures. Use checklist to identify sage-grouse habitat and key areas (e.g. leks) potentially within project areas early on so that | x | x | x | x | x | x | | x |

| BMP Number | BMP Description | Potential Threats Addressed[8]: Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
|---|---|---|---|---|---|---|---|---|---|
| | environmental considerations are included from the project's start. | | | | | | | | |
| GEN-19 | Develop and implement a company program to address sage-grouse issues, or incorporate into utility APP:<br>a. Conduct training for employees and construction crews working in sage-grouse areas about sage-grouse BMPs, ROW grant requirements, stipulations, etc.<br>b. Develop company policy, procedures, and/ or GIS databases/maps for construction, operations, and maintenance employees working in sage-grouse areas.<br>c. Include sage-grouse habitat and protection areas (e.g. PACS, etc.) in company GIS system so that appropriate avoidance areas, buffers, seasonal restrictions can be included in line routing/siting, work planning and scheduling, etc. | x | x | x | x | x | x | x | x |
| GEN-20 | Establish and enforce seasonal access restrictions for non-emergency construction activities when and where appropriate. | x | | | | | | | |
| **BMP Category: Fire** | | | | | | | | | |
| FIRE-1 | Adhere to seasonal fire restrictions. | | x | x | | | x | | x |
| FIRE-2 | a. Establish and implement a fire prevention and suppression plan (consult with local fire officials).<br>b. Minimize idling during construction or routine maintenance activities.<br>c. Park only in designated areas.<br>d. Implement use of spark arrestors.<br>e. Conduct routine vehicle inspections:<br>i. Increase inspection frequency during high fire dangers. | | x | x | | | x | | x |

| BMP Number | BMP Description | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
| | ii. Confirm vehicles are equipped with proper, functioning, fire suppression equipment.<br>iii. Inspect vehicles for build-up of flammable vegetation (and other materials) and remove.<br>f. Follow protocol for combustible materials storage, and develop a fueling plan; ensure all activities are under appropriate plan.<br>g. Clear flammable vegetation in work areas as appropriate before welding.<br>h. When welding in areas of high-risk fire danger, use a spotter. | | | | | | | | |
| FIRE-3 | Educate crews to enforce appropriate fire prevention behavior.<br>a. Prohibit smoking or smoke only in designated areas. | | x | x | | | x | | x |
| FIRE-4 | Implement appropriate bird management practices (e.g. problem nest management, electrocution prevention) to avoid fire danger. | | x | x | | x | x | | x |
| FIRE-5 | Implement vegetation management practices to remove trees or other vegetation, as appropriate, that could contribute to fire danger. | | x | x | | | x | x | x |
| FIRE-6 | When and where appropriate, use ROW as fire break (consult with local and federal fire officials). | | x | x | | | x | x | x |
| **BMP Category: Conifers** | | | | | | | | | |
| CON-1 | If pinyon pine or juniper trees exists in the ROW, remove to reduce trees growing into lines and risk of fire.<br>a. Removal of additional conifers may be conducted on a case-by-case situation to potentially improve habitat conditions. | | x | | | | x | x | x |
| CON-2 | Properly manage (dispose / remove) slash piles as a result of construction or maintenance activities. Slash piles | | | | | | | | |

| BMP Number | BMP Description | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Disturbance from Human Activities** | **Habitat Fragmentation** | **Invasive Species** | **Predation** | **Direct Mortality (Collision, Electrocution, Roadkill)** | **Fire** | **Pinyon-Juniper Encroachment** | **Habitat Loss** |
| | may increase fire fuel loads in the area as well as provide cover for predators. | | | | x | | x | x | |
| **BMP Category: Weeds and Annual Grasses/ Non-Native Vegetation** | | | | | | | | | |
| VEG-1 | Use local native seed mixes for restoration or as approved by land owner/ manager.<br>a. Landowners should be consulted on desired plant re-vegetation seed mix on private lands. Efforts should be made to control noxious and invasive weed species, including cheatgrass, that occur as a result of construction and/or maintenance activities.<br>b. In specific instances, non-native vegetation may be used to prevent soil erosion, where a native understory will be established (consult with land management agency).<br>c. Reclamation should re-establish native grasses, forbs, and shrubs during interim and final reclamation to achieve cover, species composition, and life form diversity commensurate with the surrounding plant community or desired ecological condition to benefit sage-grouse and replace or enhance sage-grouse habitat to the degree that environmental conditions allow. Consult with local resource and land management agencies for appropriate seed mixes for individual project sites.<br>d. When reseeding temporary access roads, primitive roads, and trails, use seed mixes appropriate for sage-grouse ecological conditions and consider the use of transplanted sagebrush. | | x | x | | | x | x | x |
| VEG-2 | Avoid installing power lines underground in areas where invasive/noxious weed expansion is a risk due to increased ground disturbance, both during construction and maintenance, associated with underground power lines. See Appendix A for additional information on underground power lines. | x | x | x | | | x | | x |
| VEG-3 | Vegetation removal should be limited to the minimum disturbance required by the project. Topsoil that is | | | | | | | | |

| BMP Number | BMP Description | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
| | removed in temporary use areas should be stored for re-use during reclamation. The timing of temporary vegetation removal should consider seasonal sage-grouse use (e.g. brood-rearing habitat, winter habitat, etc.). | x | x | x | x | | | | x |
| VEG-4 | Use drive and crush methods for overland travel, where feasible, rather than vegetation removal for construction of access roads.<br>a. Where feasible, temporary mats to drive over may be laid down in sensitive areas (e.g. wetlands, wet meadows, etc.) to prevent creation of tire ruts or vegetation damage. | | x | x | | | x | | x |
| VEG-5 | Inspect and wash vehicles and equipment, to the extent practical, to remove any possible invasive or noxious weed/plants materials or seeds during construction activities with significant ground disturbance. | | x | x | | | x | | x |
| VEG-6 | Conduct weed surveys in areas before and after large ground disturbing activities (e.g. transmission line construction) and implement BMPs to prevent and/or control noxious/invasive plant growth during reclamation. | | x | x | | | x | | x |
| VEG-7 | Use herbicides (approved products), where applicable and authorized, to control invasive/noxious weeds. | | x | x | | | x | x | x |
| **BMP Category: Infrastructure, Roads / Recreation** | | | | | | | | | |
| INF-1 | Build and maintain power lines using recommendations identified by the Avian Power Line Interaction Committee to minimize electrocution and collision risks (APLIC 2006, 2012, or most recent APLIC guidelines). | | | | | x | | | |
| INF-2 | In areas where off road travel use is permitted, execute “drive and crush” to reduce the impact on vegetation in | x | x | x | x | | x | | x |

| BMP Number | BMP Description | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
| | comparison to cutting/mowing. | | | | | | | | |
| INF-3 | Establish speed limits on utility access roads and other public lands roads in sage-grouse use areas, and place signage to indicate speed. Enforce speed limits for company employees and contractors.<br>a. Place “sage-grouse crossing” signage where applicable (e.g. near leks, brood-rearing habitat), to increase awareness of birds in the area and encourage speed reduction. This may reduce direct loss due to vehicle collision. | x | | | | x | | | |
| INF-4 | Limit the number of vehicles on site to those necessary to perform, monitor, and inspect work. | x | | | x | x | | | |
| INF-5 | In areas where raven nesting and associated predation on sage-grouse broods is a concern, consider methods to discourage nesting. This may include use of nest minimizing designs (e.g. monopoles, single crossarms, etc.) for new construction, or retrofitting existing structures where there is a documented problem nest.<br>a. Nest removal activities should be limited to those nests that pose a problem/risk, and as authorized by state and/or federal permits.<br>b. Removal of nest material may be necessary multiple times during nest building to discourage ravens from nesting on power poles. Nest material removal may also be most effective when done in conjunction with other methods to discourage nesting.<br>c. Migratory bird permits (e.g., utility SPUT permits) would typically only authorize removal of inactive nests or active nests (excluding eagles and threatened/endangered species) that pose a safety, operational, or fire risk. Utilities should contact the USFWS and their state wildlife agency to determine if removal of an active raven nest would be authorized.<br>d. See APLIC (2006) and www.aplic.org for additional information on nest management. | | | | x | | | | |

| BMP Number | BMP Description | Potential Threats Addressed[8]<br>Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
|---|---|---|---|---|---|---|---|---|---|
| INF-6 | Close exposed ground holes at the end of the work day to prevent sage-grouse or other wildlife from falling in and becoming trapped. | | | | | x | | | |
| INF-7 | Implement efforts to minimize fence collisions.<br>a. Evaluate the need for proposed fences, especially those within 1.25 miles of active leks and in movement corridors between leks and roost locations.<br>b. If the land manager/agency authorizes a new fence, then, where appropriate, apply mitigation (e.g., proper siting, marking, post and pole construction; see Stevens et al. 2012) to minimize or eliminate potential impacts to sage-grouse as determined in cooperation with the respective state wildlife agency. Remove fencing when not in use.<br>c. Fences within 1.25 miles of a lek pose higher risks to sage-grouse, particularly those:<br>i. On flat topography;<br>ii. Around sumps;<br>iii. Where spans exceed 12 feet between T-posts;<br>iv. Without wooden posts; or<br>v. Where fence densities exceed 1.6 miles of fence per section (640 acres).<br>d. These higher risk fence designs should be avoided. | | x | | | x | | | |
| INF-8 | Limit motorized travel to existing roads and trails, where feasible. Evaluate authorizations and implement seasonal road/primitive road/trail restrictions if continued use would result in habitat alterations or other physical disturbances.<br>a. Consider seasonal closures outside of necessary utility access. | x | x | x | x | x | x | | |

| BMP Number | BMP Description | Potential Threats Addressed[8] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
| | b. Where authorized, feasible, and appropriate, gate and lock access roads to limit access to utility and agency personnel, or private land owners. | | | | | | | | |
| INF-9 | Construct road crossings for ephemeral, intermittent, and perennial streams to minimize impacts to the riparian habitat, such as by crossing at right angles to ephemeral drainages and stream crossings. | | x | x | | | | | x |
| INF-10 | Design roads to an appropriate standard no higher than necessary to accommodate their intended purposes. Construct roads with considerations for vehicle type (size, weight), and travel frequency. | | x | x | | | | | x |
| INF-11 | Utilize biological monitors during construction to ensure environmental BMPs are implemented and followed. | x | x | | | | | | x |
| INF-12 | Contain, collect, and remove trash and construction debris regularly at construction sites and during maintenance activities to avoid attracting predators. | x | | | x | | | | |
| **BMP Category: Other** | | | | | | | | | |
| OTH-1 | Limit new noise levels at the perimeter of a lek to not exceed 10 dBA above a baseline ambient noise level (existing activity included) during the following periods:<br>a. From 6:00 p.m.to 8:00 a.m. during the initiation of breeding (March 1 – May 15).<br>b. From 2 hours before until 2 hours after at sunrise at the perimeter of a lek during active lek season (Patricelli et al. 2010, Blickley et al. 2012). | x | | | x | | | | |
| OTH-2 | Report conservation actions to the USFWS in the Conservation Effects Geospatial Database. | x | x | x | x | x | x | x | x |

| BMP Number | BMP Description | Potential Threats Addressed[8]<br>Disturbance from Human Activities | Habitat Fragmentation | Invasive Species | Predation | Direct Mortality (Collision, Electrocution, Roadkill) | Fire | Pinyon-Juniper Encroachment | Habitat Loss |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| OTH-3 | Educate the public on sage-grouse conservation efforts and inform utility customers of the need to implement sage-grouse BMPs on projects (as these efforts can impact customers through increased cost and time delays). | x | | | | | | | x |
| OTH-4 | Develop collaborative partnerships with agencies, industry, NGO’s, academia, landowners and others to further sage-grouse conservation efforts. | x | x | x | x | x | x | x | x |
| OTH-5 | Partner or conduct research to further knowledge of sage-grouse/ power line issues. Such research may include:<br>a. Investigation of impacts of power lines on sage-grouse (see UWIN 2011 for research protocols).<br>b. Effectiveness monitoring of BMPs. | x | x | x | x | x | x | | x |
| OTH-6 | Disseminate new research, BMP effectiveness data, lessons learned, etc. to aid in the ongoing improvement and refinement of BMPs. | x | x | x | x | x | x | x | x |

## 8.0 Mitigation Toolbox

Despite the use of BMPs to avoid and minimize impacts to sage-grouse and their habitat, mitigation may be required to offset unavoidable impacts. The following is a "mitigation toolbox" of potential project types that could be used for mitigation. Utilities with projects requiring mitigation (e.g., new construction of major transmission lines) should work with state and federal agencies to determine mitigation types, amounts, and locations appropriate to project-specific impacts[9].

- Conservation easements that protect sage-grouse habitat from future development and/or implement management practices (e.g., grazing strategies) to enhance habitat.
- Removal of conifers in areas identified by agencies as a priority.
- Marking or removal of high risk fences.
- Restoration of wet meadows to create or improve brood rearing habitat.
- Restoration of sage-grouse habitats impacted by fire.
- Research and testing of genetically modified sagebrush seeds to increase growth.
- Research and testing of methods to control cheat grass.
- Research on sage-grouse/power line impacts using the UWIN (2011) protocols.

[9] The BLM's Regional Mitigation Manual provides guidance for mitigation of projects on BLM lands (see http://www.blm.gov/wo/st/en/info/mitigation.html).

## 9.0 State and Federal Agency Sage-grouse Plans

State and federal resource agencies have developed or are developing specific plans for sage-grouse management, or including sage-grouse conservation objectives in agency planning documents (e.g., Land Use Plans, Resource Management Plans, etc.). Below is a list of agencies and their sage-grouse website links. Utilities and other users of this BMP document are encouraged to review state and federal agency planning documents that may contain stipulations, guidance, and site-specific information for sage-grouse in their area.

***State Agency Plans***

- California Department of Fish and Wildlife: http://www.dfg.ca.gov/regions/6/Conservation/Sage_Grouse.html
- Colorado Parks and Wildlife: http://wildlife.state.co.us/WildlifeSpecies/SpeciesOfConcern/Birds/Pages/GreaterSagegrouseConservationPlan.aspx
- Idaho Fish and Game: http://fishandgame.idaho.gov/public/wildlife/sagegrouse/
- Montana Fish, Wildlife, and Parks: http://fwp.mt.gov/fishAndWildlife/management/sageGrouse/
- Nevada Department of Wildlife: http://www.ndow.org/Nevada_Wildlife/Sage_Grouse/
- North Dakota Game and Fish Department: http://gf.nd.gov/conservation-nongame-wildlife/draft-sage-grouse-management-plan
- Oregon Department of Fish and Wildlife: http://www.dfw.state.or.us/wildlife/sagegrouse/
- South Dakota Game, Fish, and Parks: http://gfp.sd.gov/hunting/small-game/sage-grouse-management.aspx
- Utah Division of Wildlife Resources: http://wildlife.utah.gov/uplandgame/sage-grouse/
- Washington Department of Fish and Wildlife: http://wdfw.wa.gov/publications/00395/
- Wyoming Game and Fish Department: http://wgfd.wyo.gov/web2011/wildlife-1000382.aspx

***Federal Agency Plans/Documents***

- Bureau of Land Management: http://www.blm.gov/wo/st/en/prog/more/sagegrouse.html
- Natural Resources Conservation Service: http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/null/?cid=steldevb1027671

- U.S. Fish and Wildlife Service: http://www.fws.gov/mountain-prairie/species/birds/sagegrouse/
- U.S. Forest Service: http://www.fs.fed.us/research/wildlife-fish/themes/sage_grouse.php
- Environment Canada: http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=8B997117-90A0-44DF-B62C-78E65A6419A4

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## 11.0 List of Acronyms

| | |
|---|---|
| APLIC | Avian Power Line Interaction Committee |
| APP | Avian Protection Plan |
| BACI | Before-After-Control-Impact |
| BGEPA | Bald and Golden Eagle Protection Act |
| BLM | Bureau of Land Management |
| BMP | Best Management Practice |
| CEQ | Council on Environmental Quality |
| COT | Conservation Objectives Team |
| EEI | Edison Electric Institute |
| EOC | Executive Oversight Committee (WAFWA) |
| EPRI | Electric Power Research Institute |
| ESA | Endangered Species Act |
| FERC | Federal Energy Regulatory Commission |
| FLPMA | Federal Land Policy and Management Act |
| GIS | Geographic Information Systems |
| IVM | Integrated Vegetation Management |
| LUP | Land Use Plan |
| MBTA | Migratory Bird Treaty Act |
| NEPA | National Environmental Policy Act |
| NERC | North American Electric Reliability Corporation |
| NESC | National Electrical Safety Code |
| NGO | Non-governmental organization |
| NMFS | National Marine Fisheries Service |
| NRECA | National Rural Electric Cooperative Association |
| OSHA | Occupation Safety and Health Administration |
| PAC | Priority Areas for Conservation |
| PPH | Preliminary Priority Habitat |
| RISCT | Range-wide Interagency Sage-grouse Conservation Team |
| RMP | Resource Management Plan |
| ROW | Rights-of-way |
| RUS | Rural Utilities Service |
| SPUT | Special Purpose Utility (Permit) |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| UWIN | Utah Wildlife in Need |
| WAFWA | Western Association of Fish and Wildlife Agencies |
| WECC | Western Electricity Coordinating Council |

## 12.0 Glossary

**Avian Protection Plan (APP)**
An APP is a utility-specific program to reduce the operational and avian risks that result from avian interactions with electric utility facilities.

**Avian-safe**
A power pole configuration designed to minimize avian electrocution risk by providing sufficient separation between phases and between phases and grounds to accommodate the wrist-to-wrist or head-to-foot distance of a bird. If such separation cannot be provided, exposed parts are covered to reduce electrocution risk, or perch management is employed. This term has replaced the term "raptor-safe" used in the 1996 edition of APLIC's *Suggested Practices*.

**Before-After-Control-Impact (BACI)**
Observational studies conducted to determine potential impacts of variables. Data is collected both before and after the response variable, and at both control and treatment (impact) study sites.

**Circuit (single)**
A conductor or system of conductors through which an electric current is intended to flow. The circuit is energized at a specified voltage.

**Circuit (multiple)**
A configuration that supports more than one circuit.

**Co-location**
Siting new infrastructure adjacent to or near existing infrastructure. For example, new power lines may be co-located with existing power lines, roads, or pipelines where feasible.

**Conductor**
The material (usually copper or aluminum)—usually in the form of a wire, cable or bus bar—suitable for carrying an electric current.

**Configuration**
The arrangement of parts or equipment. A distribution configuration would include the necessary arrangement of crossarms, braces, insulators, etc. to support one or more electrical circuits.

**Construction Staging area**
Designated areas used temporarily to position vehicles, supplies, and equipment for access and use during power line construction.

**Core area**
Areas containing high priority habitats for sage-grouse that represent high population abundance for the species known breeding populations.

**Corvid**
Birds belonging to the family Corvidae; includes crows, ravens, magpies, and jays.

**Crossarm**

A horizontal supporting member used to support electrical conductors and equipment for the purpose of distributing electrical energy. Can be made of wood, fiberglass, concrete, or steel, and manufactured in various lengths.

**dBA**
A-weighted decibels. A measure of environmental noise.

**Density disturbance cap**
A maximum threshold of anthropogenic disturbance allowed within a given area. State sage-grouse management plans may include density disturbance caps or thresholds beyond which no new anthropogenic development is allowed.

**Distribution line**
A circuit of low-voltage wires, energized at voltages from 2.4 kV to 60 kV, and used to distribute electricity to residential, industrial and commercial customers.

**Energized**
Any electrical conducting device connected to any source of electricity.

**Facility**
As used in this manual, this term refers to all the equipment, wires, structures (e.g., poles and towers), etc., that are involved in carrying electricity.

**Fault**
A power disturbance that interrupts the quality of electrical supply. A fault can have a variety of causes including fires, ice storms, lightning, animal electrocutions, or equipment failures.

**Generation plant**
A facility that generates electricity.

**Ground**
An object that makes an electrical connection with the earth.

**Ground rod**
Normally a copper-clad steel rod or galvanized steel rod, driven into the ground so that ground wires can be physically connected to the ground potential.

**Guy**
Secures the upright position of a pole and offsets physical loads imposed by conductors, wind, ice, etc. Guys are normally attached to anchors that are securely placed in the ground to withstand loads within various limits.

**Insulator**
Nonconductive material in a form designed to support a conductor physically and to separate it electrically from another conductor or object. Insulators are normally made of porcelain or polymer.

**Kilovolt**
1000 volts, abbreviated kV.

**Latticework**
The combination of steel members connected together to make complete structures, such as transmission towers or substation structures.

**Lek**
An area where two or more strutting males attend the same location for two years or more; not necessarily consecutive years.

- *Active lek*: Based on a year-by-year review, a lek that has been attended by male greater sage-grouse during the annual strutting and breeding season.
- *Occupied lek*: A lek which has been active at least once within the last 10 years.

**Load**
Electricity demand for a given area.
**Micrositing**
The process of including site specific landscape features into route planning. Micrositing may be used to avoid sage-grouse leks, important habitats, or other sensitive features.

**Monopole**
A structure composed of a single pole or tower used to support conductors or other equipment.

**Neutral conductor**
A conductor or wire that is at ground potential, i.e., grounded.

**Outage**
Event that occurs when the energy source is cut off from the load.

**Phase**
An energized electrical conductor.

**Phase-to-ground**
The contact of an energized phase conductor to ground potential. A bird can cause a phase-to-ground fault when fleshy parts of its body touch an energized phase and ground simultaneously.

**Phase-to-phase**
The contact of two energized phase conductors. Birds can cause a phase-to-phase fault when the fleshy part of their wings or other body parts contact two energized phase conductors at the same time.

**Pole**
A vertical structure used to support electrical conductors and equipment for the purpose of distributing electrical energy. It can be made of wood, fiberglass, concrete, or steel, and manufactured in various heights.

**Power line**
A combination of conductors used to transmit or distribute electrical energy, normally supported by poles.

**Preliminary Priority Habitat (PPH)**
Essential, irreplaceable, and important sage-grouse habitats that include breeding habitat (lek sites and nesting habitat), brood-rearing habitat, winter range, and important movement corroidors. The BLM and USFWS define PPH as having the highest conservation value to maintaining sustainable sage-grouse populations.

**Priority Areas for Conservation (PACs)**
Term used in the USFWS 2013 COT Report to refer to the most important areas needed for maintaining sage-grouse representation, redundancy, and resilience across the landscape, as identified in state sage-grouse management plans.

**Problem pole**
A pole used by birds (usually for perching, nesting, or roosting) that has electrocuted birds or has a high electrocution risk.

**Pulling location**
Designated temporary use sites along a new power line construction corridor used to house conductor reels and pull conductors into insulators on overhead structures.

**Reliability**
The percentage of time a line is delivering uninterrupted electricity.

**Reroute**
The act of removing an existing line from the original right-of-way and rebuilding it along another route that will avoid the interactions encountered in the original route.

**Retrofitting**
The modification of an existing electrical power line structure to make it avian-safe.

**Rights-of-way (ROW)**
The strip of land that has been acquired by an agreement between two or more parties for the purpose of constructing and maintaining a utility easement. The width of right-of-way required by each voltage level is generally dictated by state statutes and the National Electrical Safety Code (NESC) and is a function of span length, the conductor height above ground, and the conductor's low point of sag.

**Route**
The pathway on which a right-of-way will be acquired and the new line constructed.

**Sag**
The distance measured vertically from a conductor to the straight line joining its two points of support.

**Separation**
The physical distance between conductors and/or grounds from one another.

**Siting**

The process of identifying the points in the electrical system that need new lines of connection to deliver electricity to growing or new demand centers.

**Span**
The pole-to-pole or tower-to-tower distance of a power line.

**Structure**
A pole or lattice assembly that supports electrical equipment for the transmission or distribution of electricity.

**Substation**
A transitional point (where voltage is increased or decreased) in the transmission and distribution system.

**Termination**
Structure or facility where power line ends, or where line transitions from underground to overhead.

**Transmission line**
Power lines designed and constructed to support voltages >60 kV.

**Utility corridor**
The broad area between the origin and termination of a new line, within which the potential routes lie. The area in which a new line's routing alternatives are proposed and evaluated before the final route is determined.

**Volt**
The measure of electrical potential.

**Voltage**
Electromotive force expressed in volts.

**Voltage rating**
The voltage rating of a transmission line depends on the utility's existing transmission system voltages, interconnections with other utilities, potential delivery points, and the amount of power that must be transmitted to meet load requirements. As voltages increase, the amount of power that can be transmitted increases. Various line-design parameters such as conductor size and configuration, spacing, and the number of conductors per phase (bundling) allow for increased transmission capability. Transmission voltages for carrying energy long distances are generally in the 115- to 765-kV range in North America.

**Winter concentration area**
Location(s) containing high quality sage-grouse winter habitat where concentrations (e.g. ≥50) of sage-grouse have been observed repeatedly over time.

# APPENDICES

## Appendix A: Practices Not Recommended as BMPs

Undergrounding power lines or installing perch discouragers are often raised as possible permit stipulations or mitigation options. However, both of these practices have efficacy, cost, and unintended environmental concerns that must be considered. Often, such risks may outweigh the intended benefits of these practices. Because of this, undergrounding power lines and installing perch discouragers are not recommended as BMPs and should only be used in limited applications where the associated risks/impacts are warranted. Below are details regarding the constraints associated with installing power lines underground and installing perch discouragers.

### A.1 Underground Power Lines

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. 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 need to be evaluated prior to proposing to construct an underground line.

Power lines, particularly residential distribution lines, may be installed underground in newly developed areas, where it has been found feasible to do so. However, at transmission voltages, installing lines underground is often not physically or financially feasible. Likewise, environmental concerns may preclude underground installation of power lines of both transmission and distribution voltages.

This section discusses engineering, environmental and financial considerations of undergrounding power lines.



**Figure 8. Underground power line construction (from APLIC 2012).**

***A.1.a Engineering Considerations***

*Undergrounding construction process*: For both the 230-kV and 500-kV voltage levels, the installation of underground transmission lines uses similar techniques. Large open trench installation or the more costly trenchless technologies are utilized to place the cables underground. Construction includes, but may not be limited to, clearing of the ROW, trenching, installation of duct banks or pipe networks, installation of vaults, cable splicing and terminating, and termination structure construction.

*Trenching:* Generally the most common technique for placing underground lines, open cut trenching utilizes a large surface excavation to install the required infrastructure. The typical trench dimensions vary by cable type, voltage level, and required power transfer, but in all cases require a minimum cover depth of 3 feet. While a number of cable arrangements can be achieved, soil characteristics and existing infrastructure often play the largest role of how the installations are designed. Trenching operations are typically staged such that a maximum of 300 to 500 feet of trench is open at any one time. Steel plating may be positioned over the open trench to minimize surface disruptions, while traffic controls can alleviate congestion through the project area. Emergency vehicle and local access must be coordinated with local jurisdictions as necessary.

*Installation:* Single- and double-circuit solid dielectric cable systems are often installed in duct bank configurations. Another method is duct burial.

*Vault Installation:* In a vault installation, preformed concrete splice vaults are placed at approximately 1,500- to 2,000-foot intervals depending on the maximum cable per reel length. The vaults, initially used to install the cables into the conduits, are primarily used to house the splice assemblies, and to provide access for inspections of the system. The vaults are used to sectionalize segments of cable in the event of a failure in order to locate the faulted cable and repair the required section. The typical installation time frame of each vault is approximately one week beginning with excavation, placement, compaction, and finally resurfacing of the excavated area.

*Cable Pulling, Splicing, and Termination:* Upon completion of the civil construction, cables are installed within the duct banks or steel pipes. Each cable segment is installed, spliced at each of the vaults along the route, and terminated at the transition sites where the cable connects to overhead conductors. To install the cable, a reel of cable is positioned at one end of a cable section, while a pulling rig is located at the other end. Using wire rope, each section of cable is installed into its respective conduit/steel pipe, while workers apply either water-based lubricant for solid dielectric cable or dielectric fluid for pipe type cable, to the cable jacket to minimize the frictional forces placed on the cables. Before termination or splicing operations begin, the cables are trained into the correct position using heat blankets. This process removes the curvature of the cable from being on the reel while also relieving any longitudinal strain exerted on the cable during pulling operations.

*Termination Structure Construction:* At 230-kV, either single structure transitions or larger transitions sites, resembling those of 500-kV lines, are required. Because of the large size of cable equipment required for 500-kV lines, large transition sites are the only option.

*Operations, Maintenance, and Reliability:* Underground power lines can be difficult to repair when the ground is frozen and access to underground facilities can be hampered by heavy snow, delaying outage response times. Underground power lines are susceptible to flooding and are still vulnerable to lightning damage to equipment. Underground power lines are vulnerable to dig-ins by those that may not follow proper procedures to identify underground facilities prior to excavation. Stray voltage concerns are increased with underground, versus, overhead lines. While underground systems comparatively have fewer forced outages than overhead lines, damage to the cable or components often results in longer outage durations. When a failure does occur, overhead lines can be visually inspected quickly and repaired. In contrast, underground line cable failures cannot be visually diagnosed. The cable system must be tested with specialized equipment to locate the damaged sections of the cable. Upon locating the faulty component or cable, specially trained workmen must be mobilized to repair or replace the failed components or cable resulting in potential outages of weeks or months; depending on the type of failure to be repaired, the failure location, and the availability of replacement materials. The possibility of such extended outages remove undergrounding as a viable option for customers requiring high reliability (e.g. hospitals, manufacturing plants) or in areas where there is no redundancy to serve affected customers.

*Longevity:* Underground power lines have a substantially shorter life span than overhead power lines. The Edison Electric Institute (2012) estimates that much of the underground cable installed in the 1970s and 1980s now needs replacement. The effective longevity of an underground power line is about half that of an overhead power line.

***A.1.b Environmental Considerations***

*Ground Disturbance:* While access road requirements are similar for both underground and overhead lines, underground transmission lines require a continuous excavation through all habitat types. This is in contrast to overhead lines, which result in a disturbance only at the structure locations. 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.

In sagebrush habitat continuous excavations would result in ground disturbance for the entire line route. This is in contrast to overhead lines, which result in a disturbance only at the structure locations. The extensive vegetation clearing required for underground power lines may cause fugitive dust or soil erosion problems, particularly in arid environments where re-establishing vegetation may be difficult. Underground lines would also require excavation for repairs or maintenance, which would result in ground disturbance occurring temporally over the life of the line, not just during initial construction. Ground disturbance during construction, repairs, and maintenance can result in large, permanent displacement of excavated soil and subsequent issues with re-establishing native vegetation. A University of California study (Bumby et al. 2009) found that underground power lines have more environmental impacts than overhead power lines for all categories and most scenarios in southern California.

Additionally, environmental damage can result if a buried power line is near or crosses a waterway or is in sage-brush steppe or other sensitive habitats. If an oil-filled pipe leaks, the oil would contaminate the water and surrounding soil, and damage sagebrush, causing long-term negative impacts to sage-grouse habitat.

<u>*Human Activity During Construction and Maintenance/Repairs:*</u> Construction of underground power lines can take three to six times longer than overhead line construction. Maintenance and repairs of underground power lines also take longer than overhead lines, as crews must excavate cables to identify problems and make repairs.

### ***A.1.c Financial Considerations***

One major reason that utilities do not normally install extra high voltage transmission lines underground is that the construction costs are increased by 12 to 17 times over the aboveground alternative (National Grid 2009). More recent studies have shown that costs may be reduced but are still 10 to 12 times the cost of equivalent overhead installation (Patrick Engineering 2010). The Edison Electric Institute (2012) calculated cost ranges for transmission and distribution lines installed overhead or underground in different environments. In rural areas, they found that installation of overhead transmission lines cost between $174K and $6.5 million per mile, while underground transmission lines cost between $1.4 million and $27 million per mile. Similarly, costs per mile for distribution lines in rural areas ranged from $86.7K to $903K for overhead and $297.2K to $1.84 million for underground. These additional costs must be approved by the public utilities commissions and are passed on to all the ratepayers, not just those near the area of underground installation. In addition, long-term operations and maintenance costs are higher for power lines installed underground. Also, underground lines in geographic areas with severe frost, heavy snow, and/or rocky terrain can have further increased maintenance and repair costs.

## A.2 Perch Discouragers

Nesting and perching of raptors and corvids on utility power lines and other tall infrastructure in sagebrush steppe habitats occupied by sage-grouse has been perceived as a 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 (Messmer et al. 2013).

Perch discouragers are a mitigation measure often recommended or required to prevent perching or nesting of corvids and raptors on distribution poles and transmission line structures in areas with sage-grouse or other sensitive species. Perch discouragers were originally designed to reduce raptor electrocutions by moving birds from an unsafe (electrocution risk) perching location to a safer alternative, either on the same structure or an alternate structure located nearby. Recent data has documented poor effectiveness in perch discouragers and greater effectiveness of covers for preventing electrocutions (see *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006* (APLIC 2006), pages 17-18). Despite their declining use by electric utilities, perch discouragers have been installed in attempts to dissuade raptors and corvids from perching or nesting on power poles in areas with sage-grouse or other sensitive prey species. Perch discourager research has shown limited effectiveness in preventing perching, potential for increased nesting on discouragers, and increased electrocution risk associated with perch discouragers. In areas where raven predation on sage-grouse nests is a concern, perch discouragers may aid in the accumulation of nest material (APLIC 2006), and could potentially increase raven predation pressure due to nest construction on discouragers in sensitive areas. The negative impacts of perch discouragers must be weighed against the limited benefits they may provide, particularly if they are contributing to mortalities of protected birds and facilitating increases in predator nesting populations. The avian predators of sage-grouse should also be considered, as different species exhibit different hunting strategies, and employ different hunting techniques for different prey species. For example, golden eagle diet is largely mammalian (80-90%, Kochert et al. 2002). Golden eagles prey on sage-grouse opportunistically, and typically hunt sage-grouse by stooping from a high soar (Watson 1997, Kochert et al. 2002). Consequently, power poles may not play an important role in eagle predation of sage-grouse. Golden eagles are vulnerable to electrocution mortality (APLIC 2006) and perch discouragers have been correlated with increased eagle electrocution risk (PacifiCorp, *in prep*.). Common ravens (*Corvus corax*) are known predators of sage-grouse nests, yet ravens are able to overcome perch discouragers and may experience higher nesting rates on poles with perch discouragers.

**Appendix B: WAFWA White Paper on Sage-grouse/Power Line Research**

Insert document (attached) into final pdf

## Appendix C: Examples of Different Power Line Configurations

Insert document (attached) into final pdf