Proceedings

Bats and Wind Power Generation Technical Workshop

Sponsored by Bat Conservation International,
U.S. Fish and Wildlife Service, U.S. Department of Energy's National Renewable Energy Laboratory
and the American Wind Energy Association

Hosted by FPL Energy

February 19 and 20, 2004

Report Prepared by
Energetics, Inc.
April 16, 2004

Lake Benton II Wind Site, Minnesota.
Photo Courtesy of FPL Energy.

Bat Conservation International
www.batcon.org

U.S. Fish & Wildlife Service

NREL

American Wind Energy Association

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CHAPTER 1. INTRODUCTION

On February 19-20 at a two-day workshop in Juno Beach, Florida was organized with over 20 participants (see Appendix B), including several of the world's leading bat scientists and experts from other relevant fields, the wind industry, and federal and state agencies to share information and discuss what is needed to understand and resolve issues involving bat mortality at wind turbines. Bat Conservation International and the U.S. Fish and Wildlife Service recognized the need for this workshop, which was funded by the Department of Energy's National Renewable Energy Laboratory and the American Wind Energy Association and hosted by Florida Power and Light Energy. Participants are hopeful that collaboration will yield solutions that support the continued growth of wind power production in concert with wildlife conservation.

. The purpose of the workshop was to:

- To identify what participants know and do not know about the problem of bat strikes at U.S. wind energy projects
- To discuss the state-of-the-art methods and technologies and understanding of bat behaviors that may better define the problem and/or prevent future bat kills

The workshop was not intended to make decisions about specific project proposals or who implements and finances the potential solutions. The expected outcomes of the meeting were:

- Proceedings about the state of knowledge and applicable tools to address the problem that the participants identified
- A list of potential technical solutions best suited to address the defined problem and near term priorities for a path forward

The agenda (see Appendix A) was designed to encourage dialogue and the meeting was facilitated. This document is a summary of the workshop proceedings. It captures the comments and ideas that were exchanged, and summarizes the major themes that were expressed throughout the workshop.

The morning of the first day provided the participants and the experts with a brief overview of a wind turbine project layout, infrastructure, development process, and operation from the industry perspective. Background on relevant bat studies and surveys in the U.S was also provided. Thereafter, the ten bat and migration experts invited provided a brief overview of their relevant knowledge. This session allowed for discussion about the current state-of-the-art tools and techniques used to better understand bat ecology and behavior and a report on relevant European studies.

The first of five facilitated discussions began on the afternoon of the first day addressing specific questions outlined in the agenda. The facilitator posed the focus questions and led the group in a discussion to explore and organize responses to

the focus questions. All participants, including industry and agency observers, provided ideas and they were posted on storyboards. The ten invited bats experts then independently evaluated these ideas and expressed their individual views and preferences regarding which of these should be priorities. The experts made their thoughts known by placing a dot (♦) next to those ideas on the storyboard that were a priority to them. They acted individually, not in consensus, in placing the limited number of dots each was provided. These preferences, and all of the ideas, are reflected in the tables that follow in this report.

The participants addressed the following questions:

- What are the problems associated with bats and wind turbines?
    - What are the underlying and most critical causes of the problems with bats and wind turbines?
- What are the most significant knowledge gaps with understanding and addressing the underlying causes of the problems with bats and wind turbines?
    - What is preventing an understanding of the problem?
    - What does the group need to know to address the problem?
- What tools, technologies, and information gathering techniques (e.g., radar, thermal imaging, acoustic tracking) would be most helpful in developing a better understanding of bat-turbine interactions and quantifying the magnitude of the problem?
    - What can be done to address the knowledge gaps and/or the problem?
- What actions do we need to take now to address the problems and near term priorities?
    - What is the path forward?

At the end of the second day, the participants were divided into smaller groups of 3 or 4 and discussed the details of the priority actions. At this time, some of the priority suggestions were combined, if they were related. The experts led ten breakout groups and presented their findings to all the participants. This breakout session focusing on near-term solutions addressed the following questions:

- What are the immediate next steps associated with implementing the top priority actions/solutions?
- What are the defined tasks, schedules and involved parties?

The summary session at the end of the workshop allowed the entire group to hear the results of each of the ten priority actions, engage in a discussion of the findings of the breakout groups, and provide concluding remarks. For a detailed list of the ten priority actions selected and discussed, see Table six.

An electronic copy of these proceedings can be found on http://www.nrel.gov/wind/avian_lit.html.

CHAPTER 2. PROBLEMS AND CAUSES

The discussion focused on the problems associated with bats and wind turbines and the most critical underlying causes. Separate suggestions were provided for "problems" and "causes" and a complete list can be found in Tables 2.1 and 2.2.

TABLE 2.1 PROBLEMS

♦ TOP PRIORITIES

LACK OF RELIABLE INFORMATION	INCONSISTENCY IN REGULATIONS	ECONOMIC INCENTIVES	PERCEPTION OF "GREEN ENERGY"	EVENT
• Inadequate information on bat migration ♦♦♦♦♦♦♦♦♦ • Inadequate information on how bats are being killed ♦♦♦ • Lack of rigorous data to elucidate patterns of mortality in relation to location, topography, weather, etc. ♦♦♦ • Lack of recommended deterrents and /or avoidance mechanisms ♦♦ • Lack of knowledge to provide adequate siting guidance to wind industry or 10 gram bat hitting 20-million-gram blade ♦♦ • Unexplained collisions due to siting and/or interactions between bats/turbines, i.e., echolocation and migration issues • Lack of robust methods for preventing bat mortality ♦ • Little is known about impact of turbines relative to turbine activity, bat species, local populations ♦ • Lack of knowledge of spatial and temporal use of proposed site - no data does not mean no problem e.g. MN vs. TN - no clue about East vs. West ♦	• Lack of consistent regulatory review process and requirements across states ♦♦♦♦♦ • How can EIAs be best designed and implemented best by wind farms to minimize bat mortality caused by wind turbines? ♦ • No siting guidelines, no mitigation measures ♦	• No incentive to spend money on problem ♦♦♦ • Maintaining economic development and operation of wind facilities while conserving bat populations ♦♦	• Killing bats is not 'green' in the eyes of the public & this creates an image problem ♦♦ • No reference to industry or public (both professional and general) as to what is acceptable	• Bat mortality (possible sensitive species) ♦♦ • Significant bat kills of unknown causes ♦♦ • Bats are being killed at wind turbines sites ♦ • Additive mortality to long-lived, i.e., selective species, with low reproductive rates ♦ • We don't know how significant bat mortalities at turbines are re: bat population • Bats seem to be behaving differently at wind sites in the East than elsewhere • Unexpected and unexplained high level of bat mortality at eastern U.S. wind farms - potential for taking listed species

TABLE 2.1 PROBLEMS *(CONTINUED)*

♦ TOP PRIORITIES

LACK OF RELIABLE INFORMATION	INCONSISTENCY IN REGULATIONS	ECONOMIC INCENTIVES	PERCEPTION OF "GREEN ENERGY"	EVENT
• No way to estimate population size with current technology - tools prevent getting data ♦ • An expert group on bat / wind turbine interaction has not been formed until now • Analysis for first big project in the East did not identify that bats would be killed in large numbers. • Do not know endangered bats are potentially threatened by wind power in East U.S. • Not enough is known: deterrent technology, monitoring technology, life histories of affected species				

TABLE 2.2 CAUSES

♦ TOP PRIORITIES

BAT BEHAVIOR (ECOLOGY)	INADEQUATE PROCESS	BAT POPULATION	TURBINES & SITING	INFORMATION
• Bat-turbine interaction unknown ♦♦♦♦♦♦♦♦ • Bat attraction to sound of moving blades (whooshing) • How bats respond to active vs. inactive turbines ♦♦♦♦♦♦♦♦ • Some bats are unable to avoid impact or turbulence from turbines	• Inadequate environmental review process - scope, timing, funding ♦♦♦♦♦♦♦♦♦ • Limited information flow between studies/researchers ♦♦♦♦♦♦♦ • Conflict between slower science & faster industry. Prevents peer-reviewed public ♦♦♦♦ • No formal need to conduct EIA - too short a time to conduct them for economic reasons ♦♦	• More bats than expected/ known - could be why more kills in east vs. east ♦	• Big kill caused by siting wind farms in location with dense bat migration	• Lack of high priority to get migratory bat information in eastern U.S. - difficult to study ♦

CHAPTER 3: WHAT ARE THE MOST SIGNIFICANT KNOWLEDGE GAPS?

TABLE 3. KNOWLEDGE GAPS

♦ Top Priorities

BAT / TURBINE INTERACTIONS BAT BEHAVIOR (INDIVIDUAL) USE VS. BEHAVIOR BAT ECOLOGY	STUDY DESIGN	DETECTION	MECHANISM OF MORTALITY	MITIGATION MEASURES	IDENTIFY TECHNOLOGIES
• Bat migration patterns ♦♦♦♦♦ • Importance of turbine mortality on maintenance of viable bat populations ♦♦♦♦ • Relative density of bat migration in time and space ♦♦♦ • How is bat migration (especially height) affected by weather? ♦♦♦ • Where bats fly? (scale dependent) ♦♦ • No clear idea of bat behavior during autumn migration (e.g. group size, roosts used, flight characteristics) ♦ • Do migrating bats echolocate? ♦ • How do bats respond to turbine sounds? ♦ • Are numbers killed in proportion to numbers in local area at time of kills? ♦ • Spatial and temporal use of site by bats before selection for wind development • How bats (affected) migrate over the landscape? • How does site alteration affect bat behavior and use? • Temporal variation in bat activity levels • What makes bats vulnerable to colliding with turbines?	• Best study design for mortality studies ♦♦♦♦♦♦♦ • Need to develop predictive models ♦♦♦♦ • Demographics (age, sex) and conditions (stomach contents, fat, injuries) of killed bats ♦♦♦ • Need standardized search protocols and bias-correction estimates ♦♦ • Factors contributing to risks for bats around turbines ♦ • Need intensive studies to evaluate protocols and bias corrections	• What does a turbine look like to a bat? (visually) ♦ • Test acoustic deterrents • What echoes are reflected by blades? • What sounds are produced by turbines? • Test ways to mark turbines as an obstacle to bats	• What causes bat mortality? (Impact, turbulence, disorientation) ♦♦♦♦♦ • How collisions actually occur - have not seen any • Lack of knowledge of wind turbulence and effects on bats	• Operational flexibility ♦♦♦♦♦	• Define acceptable technologies ♦♦♦♦

CHAPTER 4. MOST HELPFUL TOOLS, TECHNOLOGIES, AND INFORMATION GATHERING TECHNIQUES TO BETTER UNDERSTAND BAT-TURBINE INTERACTIONS AND TO QUANTIFY THE MAGNITUDE OF THE PROBLEM

TABLE 4. TOOLS, TECHNOLOGIES AND INFORMATION GATHERING TECHNIQUES

♦ TOP PRIORITIES

TOOLS	TECHNOLOGY	INFORMATION TECHNIQUES
• Thermal imaging - Doppler and tracking - need to distinguish between birds and bats ♦♦♦♦♦♦♦♦ • Acoustic monitoring ♦♦♦♦♦♦ • Radars ♦♦♦♦ • Trained dogs for searches ♦♦♦ • Bat necropsies ♦♦♦ • Thunk detector ♦♦ • Long distance radio tracking ♦ • Visible lights and binoculars - ceilometer ♦ • Tethered sensors ♦ • Radio tracking of local and migratory bats ♦ • Mist-netting • Photos of bat / turbine interactions • Higher resolution behavior observation tool • Low cost screening level counting tool • Smart tools that reduce labor costs while increasing surveillance coverage at key times • Play back experiments of turbine sounds - bat responses • Insect assessment (trapping / video) - helps assess mechanisms of mortality - assess bugs on rotor blades	• Wireless networking of smart sensors ♦♦ • Computer vision • Deterrent technologies • Experimental lab setup for acoustic / vortex measurements - Scale of impact vortex - Pressure changes	• Calibrated mortality daily searches ♦♦♦♦♦♦ • Mortality database (who, what, where, when) information from more sites ♦♦♦♦ - data comparisons • Measure local acoustic emissions (tower) ♦♦♦ • Literature database - visual perceptions • Suitable experimental sites • Assess ultrasound at turbines - existing data

CHAPTER 5. WHAT ACTIONS DO WE NEED TO TAKE NOW TO ADDRESS THE PROBLEMS AND NEAR TERM PRIORITIES?

During this session, the experts further defined "near term", into the following three categories: Pre-Season (within 4 months / before July), Near-Term Priorities (July-September), and Other Actions

TABLE 5. NEAR TERM PRIORITIES

♦ TOP PRIORITIES

PRE-SEASON (WITHIN 4 MONTHS / BEFORE JULY)	NEAR TERM PRIORITIES (JULY-SEPTEMBER)	OTHER ACTIONS
• Daily (twice daily) mortality searches at all sites from mid July to mid September ♦♦♦♦♦♦♦♦ • Compile bibliography ♦♦♦♦♦♦♦ • Search protocol development and testing this summer. Select sites where daily searches are conducted to evaluate optimal search protocol - nets ♦♦♦♦♦♦ • Complete analysis of existing data, weather, etc… ♦♦♦♦♦♦ • Agreed upon strategy for information dissemination and sharing ♦♦♦♦♦ • Measure acoustic emissions of turbines - including above audible range ♦♦♦♦♦ • Experimental study to show effects of switching off turbines ♦♦♦♦ • Necropsy bats and freeze specimen ♦♦♦♦ • Standardize mortality surveys (begin) - peer review ♦♦♦♦ • Daily comparisons of bat kills with weather ♦♦♦♦ • Examine feasibility of turbine locking in low wind nights ♦♦♦ • Compile data from "obscure" reports / data sets ♦♦♦ • Train dog to find carcasses ♦ • Necropsies on carcasses (stomach contents also)	• Observe strikes (visual lights & thermal imaging) ♦♦♦♦♦♦♦ • Correlate acoustic and thermal imaging data ♦♦♦♦ • Locally compare bat activity at turbine and non-turbine sites (controls) ♦♦♦ • Synergy ; more than one technique applied concurrently ♦♦♦ • Test tools and technologies at specific sites this summer ♦♦♦ • During migration observe bats using: o radar / marine o thermal imaging o acoustics ♦♦♦ • Acoustic monitor at multiple sites (July-Sept) at blade height (Species? Feeding?) ♦♦ • Pre-site survey at least 1 season data (April – Nov), acoustic, mist nets • Radar monitoring of sites during migration ♦♦ • Mortality searches vs.: o bat location o wind speed / direction o insects on blades o turbine on vs. off ♦ • Survey bat use of ridges and off-ridge habitats in vicinity ♦ • Pilot studies - observational Technical (engineering) evaluation of what is happening in	• Comparison of mortality rate with earlier movement of bats predicted by radar - birds vs. bats unknown ♦ • Compare daily bat mortality and turbine activity at multiple sites ♦ • Describe regional bat migration density pattern for Appalachia and East of Mississippi River • Identify mitigation measures for providing population benefits for threatened and endangered species • Evaluate if corridor creation increases bat numbers

TABLE 5. NEAR TERM PRIORITIES (CONTINUED)

♦ TOP PRIORITIES

PRE-SEASON (WITHIN 4 MONTHS / BEFORE JULY)	NEAR TERM PRIORITIES (JULY-SEPTEMBER)	OTHER ACTIONS
• Compile other existing data on necropsies • Correlate met ops and carcasses. Salvage data from known events • Use dog to search efficiency under different seasonal weather vegetation terrain conditions • Consult existing data sources about insect presence at wind sites • Develop test for acoustic / other deterrent - repel vs. attract away from wind turbine	• the 18m from hub towards tip of rotors • Define turbine acoustic emissions (at distance and local seasonal variation)	

CHAPTER 6. WHAT ARE THE IMMEDIATE NEXT STEPS ASSOCIATED WITH IMPLEMENTING THE TOP PRIORITY ACTIONS/SOLUTIONS?

Each breakout session was led by one or more of the scientists/experts. The top priorities identified from the previous session on near-term actions were selected for a more detailed discussion. Some of the topics were combined, if they were similar in nature. The experts were instructed to provide a soundbyte, define the task, name the type of task performers, identify a specific schedule (particularly by season), estimate some of the costs, and indicate what the immediate next steps would be to carry out these proposed priorities. Other participants were involved in the discussions, if they had a particular expertise to offer. The experts then presented the results to all the participants. Table 6 outlines the details of ten specific actions proposed to address the problem and the causes of bat interactions with wind turbines and whether the action is most appropriate during pre-season (within four months) or the near term (July-September).

TABLE 6. TOP TEN PRIORITIES

SOUNDBYTE	TASKS	PERFORMERS	SCHEDULE	COSTS	IMMEDIATE NEXT STEPS
Thermal Imaging: observe strikes (Near term)	• Record behavior at one site • Correlate with acoustics and mortalities • Mid-July, mid-September (Nightly)	• TVA • Mountaineer • BU (Post doctorate + graduate student)	Field Work Mid-July, Mid September Analysis / Report October- March	(Overhead) • Camera (rent) $6K • Computer $3K • Memory $6K • People (field) $3+2/month: $10K • Analysis $3K/month: $18K • Travel $1K/month: $ 2K • Housing $60/day: $ 7K • Instrument Calibration (Pre-field) 1 month $ 3K • Insurance / rabies $ 1K	• Kunz / Indigo Systems re: camera • TVA • Mountaineer
Observe Acoustic: detection strikes (Near term)	(Acoustic) • Monitor mid-July, mid-September (Nightly) • Spatial and temporal variations (multi-sites) • Feeding vs. non-feeding • Identify by species	• TVA • Calgary • Mountaineer • Buffalo Ridge • Non-altered sites	Field Work Mid-July, Mid September Analysis / Report August - November	• 7 Anabats @ $2K = $14K 3 Met 4 Balloon @ $1K = $4K Accommodations • Persons (2) @ $4K = $8K • Travel @ $1K/month = $2K • Analysis 2 mo $2K = $4K • Rabies etc. $1K	• Contact Titley about Anabat costs and delivery • Use of sites: o TVA o Calgary o Mountaineer o Buffalo Ridge

TABLE 6. TOP TEN PRIORITIES *(CONTINUED)*

SOUNDBYTE	TASKS	PERFORMERS	SCHEDULE	COSTS	IMMEDIATE NEXT STEPS
Synergy (Pre-season)	• Concurrent evaluation of: o Radar o Acoustic o Thermal imaging o Ceilometer – visual o Wind – Wx data o Ground surveys o Insect trappings • Select 1 or 2 wind farms / sites • Coordinate teams of observers • Compare results probably via meetings	• Coordinator (boss) • Most available field workers	Set restricted period in August 2004	• Cost proportional to days in field • Break out cost of search on the ground • Cost of analysis and comparison	• Select field czar • Identify funding source
Dead bats (Pre-season)	Develop protocols for: 1. Field data collection (who, what, where, when) 2. Laboratory analysis (necropsy, stomach content etc.) 3. Archiving of specimen	1. Experienced search crews, industry statisticians, vets, bat biologists, carcass coordinator 2. Veterinarians, diet analysis experts, physiologists, vet students, carcass coordinator 3. Museum curators	1. Immediately (this season) 2. 1 year (necropsy now!) 3. 1-2 years	1. < $10K (salary) 2. $50K / year 3. $5K / year (museum support)	1. Coordinator and funding 2. Prepare field protocol and implement 3. Analyze existing specimen 4. Develop partnerships with labs and museums
Other Existing Data (Pre-season)	1. Compile existing data 2. Summarize and make available 3. Analyze data	1. Ed Arnett, coordinator, industry liaison, GIS expert 2. Coordinator, data manager 3. Researchers, meteorologists, engineers	1. This year 2. This year 3. Next few years	1. $10K salary 2. < $10K 3. Pro bono?	1. Coordinator appointed 2. Identify and contact wind farm operators

TABLE 6. TOP TEN PRIORITIES *(CONTINUED)*

SOUNDBYTE	TASKS	PERFORMERS	SCHEDULE	COSTS	IMMEDIATE NEXT STEPS
Acoustic Emission Spectrum (Pre-season)	• Study of several replicates of 3-4 turbine types over a range of wind speeds; measuring infrasound-ultrasound spectrum. • Find sponsor; Write RFP; Review RFP; Solicit proposals; Review and select proposals; Perform work; Write; Review; Measure; Publish	Contracted experts: • Companies • Universities	Complete job in 12 – 18 months	$100,000	Find sponsor and execute
Testing of Search Protocol and Measurement of Biases (Pre-season)	• Protocol development (i.e., 1x/day/turbine) • Field implementation • Data analysis to develop 'optimal' protocol with bias correction	• Existing study sites • Biometricians • PIs / students, coordinators etc.	• Protocol development by June 1st, including peer review • Study (July 15 – Sept 15)	Consistent with labor, travel and other associated costs per site (Mountaineer ~ $50,000)	• Specifics of protocol testing developed and peer reviewed • Decide where / who
Compile Bibliography (Pre-season)		BCI, Inc.	April 30	Salary and overhead	• Email group • Literature search • Upload
Information Exchange (Pre-season)	Determine what is shared when and by whom	Central repository	• Process by 04/30 • Initial reports by 11/30 • Web up by 05/30	• Salary and overhead • Web hosting	• Agreement on process/ timing • Launch website • Apply for funding
Low Wind Speed Rotor "Stop Lock & Park" (Pre-season)	• Test at high migration – stop half of wind farm • Summarize and check manufacturing	Florida Power & Light	August 2004	• $20,000 • Energy lost several days • Manpower • Manufacturer information	Ask Florida Power & Light

APPENDIX A. AGENDA

BATS AND WIND POWER GENERATION TECHNICAL WORKSHOP

Sponsored by Bat Conservation International, U.S. Fish and Wildlife Service, U.S. Department of Energy and the American Wind Energy Association

Hosted by FPL Energy Group of Florida Power and Light
700 Universe Blvd., Juno Beach, FL 33408

February 18, 19 and 20, 2004
Final Agenda

Purpose and Objectives

- To identify what participants know and do not know about the problem of bat strikes at U.S. wind energy projects
- To discuss the state-of-the-art methods and technologies and understanding of bat behaviors that may better define the problem and/or prevent future bat kills

Expected Outcomes

- A brief report about the state of knowledge and applicable tools to address the problem that the participants identified in Day One of the meeting
- A list of potential technical solutions best suited to address the defined problem and near term priorities for a path forward

Non-Purpose

- To make decisions about specific project proposals or who implements and finances the potential solutions

Evening of Wednesday Night ---- February 18th

6:30 P.M.	**NO-HOST DINNER** **MEET IN HOTEL LOBBY**

Day One — Thursday February 19

8:00 A.M. – 8:30 A.M. **CONTINENTAL BREAKFAST**

Welcoming Remarks

Bonnie Ram, Energetics (workshop facilitator) - Introduction and Workshop Purpose
Bob Fritz, FPL VP of Operations – Host Welcome
Alex Hoar, U.S. Fish and Wildlife Service – Sponsors Welcome

8:30 A.M. - 10:00 A.M. **BACKGROUND PRESENTATIONS**

The morning session will consist of several overview presentations running between 15-20 minutes with time for questions and answers. Presenters will include:

Randy Hoyle – FPL Energy Wind Construction/Development, Overview of a Wind Turbine Project: Layout, Infrastructure, and Operations
Merlin Tuttle – Bat Conservation International, Background on Relevant Bat Studies in the U.S.
Jessica Kerns – Appalachian Associates, Survey Methods and Findings at the Mountaineer Project in West Virginia
Charles Nicholson – TVA, Methods and Findings at Buffalo Mountain in Tennessee

10:30 A.M. – NOON **EXPERT PRESENTATIONS**

The ten presenters will provide a brief overview of relevant knowledge. Presentations will be a maximum of 15 minutes. This session will allow for questions and answers and brainstorming.

Bill Evans puts wind power into broad conservation perspective, discusses projected numbers and locations of wind turbines in northeast, what triggers bird migrations, and weather and topographic factors that increase risks.

Ron Larkin introduces radar as a tool for observing flying animals and describes examples of field research with bird kills at tall towers and skyscrapers.

Robert Barclay presents background on bat/wind power experience relative to topography in western Canada and summarizes his observations on timing and nightly variation among migratory bats.

Paul Cryan summarizes knowledge of long-distance bat migration, illustrating geographic and seasonal trends and high altitude flight and discusses observations of group travel, and past versus present numbers of red bats.

Gareth Jones reports on relevant European concerns and discusses hypotheses for disproportionate bat kill rates.

Tom Kunz discusses potential importance of thermal imaging and infrared monitoring of bats at wind turbines, mortality assessment, sampling methodologies, and modeling of cumulative impacts.

Jeff Gore represents eastern bat working groups and state biologists in emphasizing need for unified, regional approaches, not just discrete site evaluations.

Ed Arnett will introduce himself as the project coordinator for bats and wind power generation project at BCI and briefly summarize his relevant background.

NOON – 12:45 P.M. **LUNCH SERVED IN-HOUSE**

12:45 P.M. – 1:15 P.M. **CONTINUE WITH EXPERT DIALOGUE**

Complete the expert presentations and continue with questions and answers

1:15 P.M. – 3:00 P.M. **FACILITATED DISCUSSION WITH FOCUS QUESTIONS**

The facilitator will pose two focus questions to address during the afternoon. She will lead the group in a discussion to explore, brainstorm, organize and analyze responses to the focus questions.

- What are the problems associated with bats and wind turbines?
    - What are the underlying and most critical ***causes*** of the problems with bats and wind turbines?

3:00 P.M. – 3:30 P.M. **BREAK**

3:30 P.M. – 5:00 P.M.	**FACILITATED DISCUSSION WITH FOCUS QUESTIONS**

- What are the most significant ***knowledge gaps*** with understanding and addressing the underlying causes of the problems with bats and wind turbines?
    - What is preventing an understanding of the problem?
    - What does the group need to know to address the problem?

5:00 P.M.	**ADJOURN**

THURSDAY EVENING – 6:00 P.M.	**GROUP DINNER**

Day Two — Friday, February 20, 2004

8:30 A.M. – 10:00 A.M.	**FACILITATED DISCUSSION WITH FOCUS QUESTIONS**

The facilitator will summarize what was learned from the previous day and introduce focus questions for discussion.

- What tools, technologies, and information gathering techniques (e.g., radar, thermal imaging, acoustic tracking) would be most helpful in developing a better understanding of bat-turbine interactions and quantifying the magnitude of the problem?
    - What can be done to address the knowledge gaps and/or the problem?

10:00 A.M. – 10:30 A.M.	**BREAK**

10:30 A.M. – NOON	**CONTINUATION OF THE FACILITATED SESSION**

- What actions do we need to take now to address the problems and near term priorities?
    - What is the path forward?

NOON - 1:00 P.M.	**LUNCH SERVED ON-SITE**

1:00 P.M. – 3:00 P.M.	**CONTINUATION OF THE FACILITATED DISCUSSION**

Break-up into smaller "caucus groups" to address:

- What are the immediate next steps associated with implementing the top priority actions/solutions?
- What are the defined tasks, schedules and involved parties?

3:00 P.M. – 3:30 P.M.	**BREAK**

3:30 – 5:00 P.M.	**WRAP-UP AND FINAL THOUGHTS**

Is there anything key that has been missing from the discussions?
What are your final thoughts with regard to the discussions?

5:00 P.M.	**ADJOURN**

APPENDIX B. PARTICIPANTS

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