APPENDIX B. SIDEBOARDS FOR SMART TECHNOLOGY STRATEGIES TO ACHIEVE OPERATIONAL AVOIDANCE FOR TRICOLORED BAT.

Activity-Based Informed Curtailment (ABIC) [1]Approach (Option 2)

1. **Sideboards**
    a. Acoustic detectors should be located on a minimum of 10 percent of project turbines (ABIC turbines) if targeting all bat calls or on a minimum of 15 percent of project turbines if targeting tricolored bat (TCB) calls only or calls ≥40 kHz (FAQ #15 for more details).
        i. Acoustic detectors should be placed on the nacelle or within the rotor-swept zone (RSZ) where possible. Additional detectors can be placed on the ABIC turbine tower (~20 meters (m)) and ground (3 m). Data from ground (~3 m) and tower detectors below the RSZ can be incorporated into the ABIC approach to increase the sample size and is strongly recommended in most locations. Coordinate with the local Field Office on their site-specific recommendations.
        ii. Additionally, other species' calls can be used to supplement TCB calls and increase sample size (e.g., all recorded calls >40 kHz). If tower (i.e., below the RSZ) and/ or ground-based acoustics data are collected, call files must be paired with the closest turbine's 10-minute rolling average temperature and wind speed data (i.e., collected on the nacelle).
    b. Predictor data collected should include wind speed, temperature, date, and time of night measured over 10-minute intervals.
    c. Carcass trigger: If a TCB carcass is found when implementing an ABIC program:
        i. The fatality must be reported to the local Field Office within 1 business day of discovery.
        ii. Consult with the local Field Office regarding the ABIC program and if additional ABIC adjustments can be made, including but not limited to one of the following in coordination with the local Field Office:
            1. Selecting a more protective ABIC strategy that incorporates all bat calls versus only TCB or high-frequency calls.
            2. Collecting additional acoustic data, including data from the turbine with the fatality.
            3. Constraining blanket curtailment to the turbine(s) in proximity to the fatality and/or during the period in which the fatality occurred.
            4. If no ABIC adjustments can be made, the project should operate under Option 1 (blanket curtailment).

[1] This can also be referred to as the activity-based informed curtailment, but activity-base informed curtailment is not solely based on acoustic data.

2. Program Development

a. For projects that need to collect predictor data before implementation of Option 2, submit an ABIC development plan (i.e., number of turbines, placement of acoustic detectors, and project layout), which needs to be reviewed and approved by the local Field Office. Approval is the issuance of a Technical Assistance Letter (TAL) that will include the details specific to the project. Layout approval will be based on the distance to suitable TCB habitat and ensure that ABIC turbines are spread throughout the project site (i.e., a stratified randomized approach). The following items should be included as part of the development plan. The local Field Office may request additional information.
    i. GIS files of all project turbines and ABIC turbines (i.e., turbines that will be fitted with acoustic detectors), and
    ii. acoustic detector and microphone information (including but not limited to the make and model, the anticipated detection distance for low and high-frequency calls) to the local Field Office.

b. A minimum of one year of acoustic and predictor data should be collected for the development of a project-specific ABIC program. During development, turbines will be operating using Option 1[2].

c. At the end of Year 1 or prior to implementing ABIC for projects with existing predictor data, an ABIC program proposal should include at a minimum the following information. The local Field Office may request additional information.
    i. The ABIC strategy for the project must include all identified TCB acoustic call files from Year 1 (determined by Service-approved auto-ID programs[3] and manually vetted[4]) and must be as equally protective as Option 1 (i.e., demonstrate that, under the proposed strategy, all turbines would be feathered during all periods when 90% of TCB calls (or >40 kHz calls) were detected, or at minimum, under the conditions [season, temperature, wind speed, etc.] specified in Option 1).
    ii. A brief CV highlighting the qualifications of the person(s) vetting call files should be included in the proposal.
    iii. The project should use an ABIC smart curtailment technology to generate the ABIC strategy that will reduce the risk to TCB by 90 percent.
    iv. We recommend that projects include Tables and/or Figures showing the seasonality of TCB and all bat activity and the corresponding 10-minute

[2] If a project already has predictor data collected at the site, ABIC can be developed and implemented starting Year 1 and bypassing the need for operating under Option 1.

[3] Automated Acoustic Bat ID Software Programs | FWS.gov. Note, all auto-ID programs are considered candidates in portions of ND, SD, MT, NE, and KS. In these areas two auto-ID programs should be used and the results cross-referenced. This process and a depiction of these areas are available in the Service's 2023 Range-Wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (page 8, step 6).

[4] Currently approved programs have some bias in correctly identifying TCB calls to the 0.05 MLE value typically used for Indiana and northern long-eared bats. We recommend that all call files identified as TCB be vetted even if the MLE is below 0.05 to mitigate this bias.

rolling average temperature and wind speed collected at the turbine nacelle.

3. **Program Structure and Implementation**
    a. ***For projects that need to collect predictor data:*** All turbines will operate under blanket curtailment regime (Option 1) and a subset of turbines will collect acoustic data and predictor data (see below for more information) for the entire active season (i.e., 1 year for projects within the year-round active zones).
        i. Acoustic detectors should be scheduled to turn on 30 minutes before sunset and turn off 30 minutes after sunrise daily.
        ii. Post-construction mortality monitoring (PCMM) should occur in Year 1 at the approved level of effort (i.e., g of 0.08) described under #3.b.i. in the TCB Wind Avoidance Guidance. Report all PCMM data as described under #3.c of the TCB Wind Avoidance Guidance.
        iii. At the end of Year 1, projects will create an ABIC program proposal using data collected (e.g., acoustic data, temperature, windspeeds, etc.) in Year 1 and send to local Field Office for approval (i.e., approval will be an updated TAL). Note, if your project is waiting for an updated TAL (i.e., ABIC approval), the project can continue to operate under Option 1 and does not need to complete additional post-construction monitoring until the updated TAL is received. Year 2 under Option 2 (described below) will start once the project receives an updated TAL.
    b. ***First year implementing ABIC operational avoidance approach***[5]
        i. All turbines will operate under Service-approved ABIC program developed using data collected in Year 1 or previously by the project. The ABIC program will be described in the TAL.
        ii. PCMM should occur at the approved level of effort described under #3.b.ii. in the TCB Wind Avoidance Guidance. Report all PCMM data as described under #3.c of the TCB Wind Avoidance Guidance.
        iii. Projects may choose to continue to collect acoustic data in the first year implementing ABIC to help further refine the project's ABIC strategy. Adjustments may be made to all curtailment factors, including season, time of night, temperature, precipitation and wind speed if supported by the data. See Reporting section for required information.
        iv. If ABIC program is effective (i.e., no TCB carcasses detected), operation can continue under this ABIC program at the project.

4. **Reporting Requirements for Predictor Data (e.g., acoustic data, weather, and others)**

[5] This would be Year 2 for projects that needed to collect acoustic and predictor data prior to designing the ABIC approach or Year 1 for projects with existing predictor data.

a. Reports should be submitted by January 31, annually as described in the TCB Wind Avoidance Guidance under #3.c, unless otherwise approved by the local Field Office.
b. If project(s) are collecting predictor data projects should provide the auto-ID output Excel spreadsheets with the following information amended for each bat call file. All bat species should be included.
    i. A column that shows that the TCB call was vetted. Note vetting of other bat species call files is not required but encouraged especially if other listed species are detected;
    ii. A column that has the name of person(s) who vetted the confirmed TCB call file; and
    iii. Columns with corresponding 10-minute rolling average temperature and wind speed data for each TCB call file[6]
    iv. Projects should provide a brief CV for each manual vetter that describes their experience.
c. If the project would like to complete the required PCMM in future years using acoustics, we request the following data to show the relationship between exposed bat calls (all bats) and fatalities.
    i. Determine the number of exposed bat calls (all species) and relate this to the number of carcasses found. (e.g., graph of the two values and correlation coefficient).

Real-Time Acoustic-Activated Curtailment Approach (Option 3)

1. **Sideboards**
    a. Only smart curtailment tools that will trigger the turbine(s) within a designated zone to stop rotating (i.e., approximately less than 1 rotation per minute [rpm]) within 2 minutes of a bat acoustic call being detected are eligible to be used under Option 3.
    b. Units should be placed on a minimum of 10 percent of turbines[7] (See FAQ #14). Turbines should be assigned to "zones" as determined by the project proponent based on tricolored bat risk and/or other logistic constraints.
    c. Acoustic detectors should be scheduled to turn on 30 minutes before sunset and turn off 30 minutes after sunrise daily.
        i. Carcass trigger: If a TCB carcass is found when implementing Option 3, the fatality must be reported to the local Field Office within 1 day (24 hours) of discovery.

[6] See Peterson (2021), Behr et al. (2017), Barré et al. (2023), and others that have implemented ABIC or similar strategies.
[7] Except when there are fewer than 15 turbines. Please discuss the protocol with the local Field Office in coordination with the Regional Office to ensure consistency.

ii. Consult with the local Field Office regarding the Real-Time Acoustic-Activated system and determine if the system functioned properly and if adjustments can be made, including but not limited to:
    1. Maintain blanket curtailment for the turbine with the fatality (and potentially turbines in immediate proximity or in the same zone, or turbines with similar environmental conditions [e.g., proximity to habitat, wind speed regimes, etc.]), while all other turbines revert to acoustic-activated smart curtailment.
    2. Configure the smart curtailment system to operate during time periods outside of the period in which the fatality occurred (e.g., if the fatality occurred during the period of August 1 to September 30, smart curtailment starts operation on October 1 and continues into the spring and summer prior to August 1).
    3. Redesign zone strategy where zones may be expanded to encompass more detector units leading to turbines being curtailed based on bat detections recorded from an increased number of acoustic detectors.
    4. Collect additional acoustic data, including data from the turbine with the fatality or turbines in proximity to the fatality or by possibly adding more detectors for the zone redesign.
    5. If no adjustments can be made, the project should operate under Option 1 (blanket curtailment).

d. PCMM should occur in Year 1 at the approved level of effort described under #3.a in the TCB Wind Avoidance Guidance. Report all PCMM data as described under #3.c of the TCB Wind Avoidance Guidance.

e. At end of Year 1, projects will download and analyze acoustic call files (using a Service-approved auto-ID program) and Supervisory Control and Data Acquisition (SCADA) data to address the following questions:
    i. Did the real-time curtailment system operate as expected? For example, were all turbines feathered within the designated zone when a bat was identified by the smart curtailment program? If not, when did this occur and were there bat carcasses (not TCB) found at these turbines as a result? Can this be avoided in the future?
    ii. Was the smart curtailment system identifying non-bat calls (i.e., noise) as bats?
    iii. Was Option 3 equally as protective as Option 1 (i.e., were turbines feathered during all periods when bat calls were detected, at minimum, under the conditions [season, temperature, wind speed, etc.] specified in Option 1)?

2. **Program Implementation**
    a. Prior to Year 1, the following information needs to be coordinated and approved by the local Field Office. We recommend obtaining a Technical Assistance Letter (TAL) for the local Field Office.

i. General information about the real-time smart curtailment technology (e.g., DARC/ EchoSense, or other system), including but not limited to, how the technology will be connected to the turbines' SCADA system, troubleshooting protocol (e.g., can the project spot check random turbines throughout the bat active period, system health monitoring and alerts for issues detected), and microphone placement.
ii. A maintenance schedule to ensure that equipment is operating correctly and to replace old or malfunctioning equipment (i.e., microphones and acoustic detectors).

b. Projects should submit maps and GIS files of all project turbines and turbines that will be fitted with acoustic detectors to the local Field Office.
i. Layout approval will be based on the real-time outfitted turbine's distance to suitable TCB habitat and associated "zone" to ensure that turbines and their associated "zone" turbines are grouped based on expected relative risk to TCB. For example, if a project has forests along the east side of the project, we expect at least one turbine to be outfitted with the real-time smart curtailment technology and that turbines on the east side of the project be located in the same zone or multiple zones if more than one turbine is outfitted in this section of the project.

c. Projects should also show (e.g., test) that the real-time smart curtailment technology is operating as expected and communicating with the turbine's SCADA system.

3. **Reporting**
a. Reports should be submitted by January 31, annually as described in the TCB Wind Avoidance Guidance under #3.c, unless otherwise approved by the local Field Office. Additional information should also be included in the annual report, below. The local Field Office may request additional information.
i. Auto-identified bat call files (determined by Service-approved auto-ID programs[8] and manually vetted[9]). Manual vetting only needs to happen for calls auto-identified as TCB using a USFWS-approved software.
ii. A brief CV highlighting the qualifications of the person(s) vetting call files should be included in the report.
iii. If the project would like to complete requested PCMM in future years, we request the following data to show the relationship between exposed bat calls (all bats) and fatalities.

[8] Automated Acoustic Bat ID Software Programs | FWS.gov. Note, all auto-ID programs are considered candidates in portions of ND, SD, MT, NE, and KS. In these areas two auto-ID programs should be used and the results cross-referenced. This process and a depiction of these areas are available in the Service's Range-Wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (page 8, step 6).
[9] Current approved programs have some bias in correctly identifying TCB calls to the 0.05 MLE value typically used for Indiana and northern long-eared bats. We recommend that all call files identified as TCB be vetted even if the MLE is below 0.05 to mitigate this bias.

b. Projects should provide the auto-ID output Excel spreadsheets with the following data amended for each bat call file. All bat species should be included.
    i. A column that shows that the TCB call was vetted. Note vetting of other bat species call files is not required but encouraged especially if other listed species are detected;
    ii. A column that has the name of person(s) who vetted the confirmed TCB call file; and
    iii. A column addressing if the turbine was feathered at the time of this acoustic call (i.e., spinning at less than 1 RPM).
    iv. Wind speed data at the turbine at the time of the TCB call(s), if available.
c. If the project would like to complete the required PCMM in future years using acoustics, we request the following data to show the relationship between exposed bat calls (all bats) and fatalities.
    i. Determine the number of exposed bat calls (all species) and relate this to the number of carcasses found. (e.g., graph of the two values and correlation coefficient).

LITERATURE CITED

Barré, K., J.S. Froidevaux, A. Sotillo, C. Roemer, and C. Kerbiriou. 2023. Drivers of bat activity at wind turbines advocate for mitigating bat exposure using multicriteria activity-based curtailment. *Science of the Total Environment*, *866*, p.161404. https://doi.org/10.1016/j.scitotenv.2023.161404.

Behr, O., R. Brinkmann, K. Hochradel, J. Mages, F. Korner-Nievergelt, I. Niermann, M. Reich, R. Simon, N. Weber and M. Nagy. 2017. Mitigating bat mortality with turbine-specific curtailment activitys: A model based approach. *Wind Energy and Wildlife Interactions: Presentations from the CWW2015 Conference*, p.135-160. Springer International Publishing. http://dx.doi.org/10.1007/978-3-319-51272-3_8.

Peterson, T.S., B. Mcgill, C.D. Hein, and A. Rusk. 2021. Acoustic exposure to turbine operation quantifies risk to bats at commercial wind energy facilities. *Wildlife Society Bulletin*, *45*(4), pp.552-565. https://doi.org/10.1002/wsb.1236.

U.S. Fish and Wildlife Service. 2023. Automated Acoustic Bat ID Software Programs. https://fws.gov/media/automated-acoustic-bat-id-software-programs.