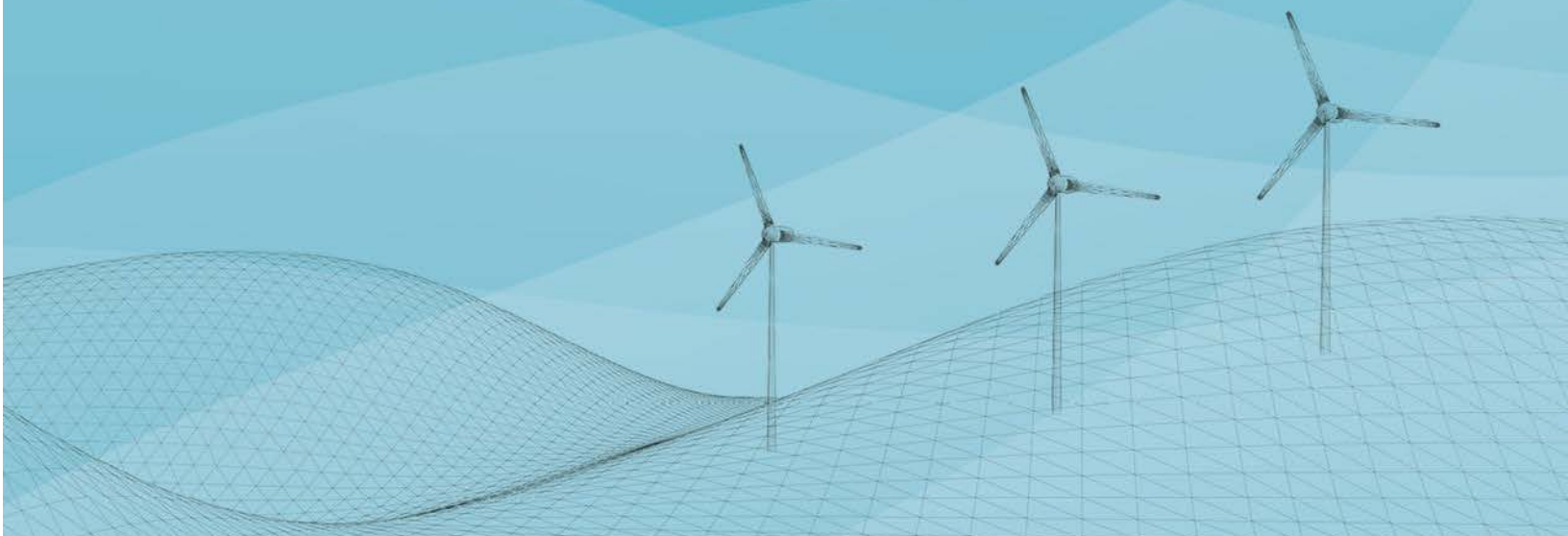
COLLEGIATE WIND COMPETITION
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY COLLEGIATE WIND COMPETITION 2024

Rules – Phases 2 and 3



September 19, 2023

DOE/GO-102023-6048

Preface

This competition will be governed by 15 U.S.C. §3719 and this Official Rules document, which establishes the prize rules and requirements for the competition. This is not a procurement under the Federal Acquisitions Regulations and will not result in a grant or cooperative agreement under 2 CFR 200. The Prize Administrators reserve the right to modify this Official Rules document if necessary and will publicly post any such notifications as well as notify registered prize participants. In case of a discrepancy with other competition materials or communication, this document takes precedence.

The National Renewable Energy Laboratory is supporting the U.S. Department of Energy on the development and administration of this prize.

Prize Administrator means both the Alliance for Sustainable Energy operating in its capacity under the Management and Operating Contract for NREL and Wind Energy Technologies Office (WETO). When the Prize Administrator is referenced in this document, it refers to staff from both the Alliance for Sustainable Energy and WETO staff. Ultimate decision-making authority regarding prize matters rests with the Director of WETO.

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1 Introduction

The U.S. Department of Energy (DOE) Wind Energy Technologies Office's (WETO) Collegiate Wind Competition (CWC, also referred to as the "competition" in this rules document) invites interdisciplinary teams of undergraduate students from a variety of academic programs to solve complex wind energy challenges. Through the competition, WETO intends to offer students direct industry experience, valuable exposure to wind energy career pathways, and greater knowledge of wind energy's potential to contribute to a clean energy future. The competition will select up to 35 teams to start, making them eligible to compete for a cash prize pool of up to $280,000.

Each year, the competition identifies a new challenge and set of activities that address real-world research questions, thus demonstrating skills that students will need to work in the wind or wider renewable energy industries. The Collegiate Wind Competition 2024 challenge requires participants to compete simultaneously in four contests:

- **Turbine Design Contest**: Design, build, and present a unique, wind-driven power system based on market research.
- **Turbine Testing Contest**: Test the wind turbine in a competition wind tunnel at the final event.
- **Project Development Contest**: Research wind resource data, transmission infrastructure, and environmental factors to create a site plan and financial analysis for a hypothetical wind farm.
- **Connection Creation Contest**: Partner with wind industry professionals, raise awareness of wind energy in your local community, and work with local media to promote your team's accomplishments.

The competition does not prescribe a power system market[1] or wind regime. It is expected that each team will participate in all four contests.

1.1 Background

The U.S. Energy Information Administration projects that the share of renewables in the U.S. electricity generation mix will increase from 21% in 2020 to 42% in 2050, with wind and solar generation playing a significant role.[2] The U.S. Department of the Interior, DOE, and U.S. Department of Commerce also announced a shared goal to deploy 30 gigawatts (GW) of offshore wind energy in the United States by 2030, which could support more than 44,000 jobs by 2030 and nearly 33,000 additional jobs in communities supported by offshore wind activity.[3] As more wind energy is incorporated into the U.S. power generation mix, qualified workers are needed to fill jobs at all levels.

The competition increases renewable energy job preparedness for students. Specifically, the CWC's objective is to prepare students from multiple disciplines to enter the wind energy workforce by providing real-world experience for researchers, scientists, engineers, educators,

[1] For example, https://www.ferc.gov/electric-power-markets
[2] https://www.eia.gov/outlooks/aeo/.
[3] https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

project managers, and business and sales forces. Wind-energy-specific advanced degrees are not required for many of these jobs, but having wind-related experience is highly valuable.[4]

New for this year, the CWC will encourage students to incorporate offshore wind energy generation as part of a hybrid power plant, prompting students to consider development and operation for ancillary grid benefits, alternative forms of market participation and offtake agreements, and multitechnology solutions.

1.2 Competition Overview

The Collegiate Wind Competition 2024 challenges teams to compete in four contests: Turbine Design, Turbine Testing, Project Development, and Connection Creation. Within each contest, teams' submissions receive points toward winning the contest. The competition is divided into three phases. This document only covers the requirements for Phases 2 and 3. Phase 1 – Preliminary Team Selection is covered in a separate rules document that was released earlier this year. This document only applies to Phase 1 winners. Phase 2 is only open to Phase 1 winners and Phase 3 is only open to Phase 2 winners.

1.2.1 Phases

All four contests that make up the competition will be held in three phases that determine a team's level of participation. Competitors will have a chance to win prizes at each phase, for a total prize pool of up to $280,000.

- Phase 1 – Preliminary Team Selection: up to $2,000/team from a total cash prize pool of up to $70,000.
    - The submission asks teams to share their motivations for entering the competition and describe their capacity to perform well in the competition.
    - It is recommended and expected that teams leverage this prize to support their participation in Phase 2 of the competition.
    - A maximum of 35 teams will be selected from the pool of submissions.
    - The full set of submission requirements are described in the Phase 1 rules document.
- Phase 2 – Competitor Selection: up to $15,000/team from a total cash prize pool of up to $180,000.
    - The Competitor Selection phase is the chance for students to demonstrate their skill sets in achieving competition objectives. Submissions, structured as written reports and videos, have been designed to evaluate how likely the team is to be successful in competing in the rest of the competition.
    - In this phase, teams will complete submissions during the fall semester for four contests: Turbine Design, Turbine Testing, Project Development, and Connection Creation. CWC organizers will use those submissions to determine the 12 teams that will earn a cash prize and compete in Phase 3, which will take place during the Spring 2024 semester.
    - Details on submission requirements, how the submissions will be evaluated, and when they are due are included in this Phases 2–3 rules document.

[4] https://www.nrel.gov/docs/fy19osti/73908.pdf

- Phase 3 – Grand Prize: up to $30,000 prize pool for winners in a variety of categories, defined below.
    - This final phase includes multiple submissions for each of the four contests. The final submissions will be evaluated at a final event, which includes the chance to present to industry experts, test the model turbines in the competition wind tunnels, network with industry professionals, and get a preview of what the wind energy industry looks like.
    - Teams will compete throughout the spring semester to win the awards listed below and a portion of the prize pool.
    - The final event is expected to run from May 5 to May 9, 2024, at the American Clean Power Association's CLEANPOWER Conference & Exhibition in Minneapolis, Minnesota, or a similar venue and timeline.[5]
    - All points earned throughout the competition for the four contests will roll up into a final score that will be combined with program policy factors to determine the final winners. Teams may win multiple awards. Awardees will split a $30,000 prize pool. Awards will include but will not necessarily be limited to the following:
        - First-place winner: The team that earns the highest combined score.
        - Second-place winner: The team that earns the second-highest combined score.
        - Third-place winner: The team that earns the third-highest combined score.
        - Turbine Design Contest winner: The team that earns the highest combined score from all Turbine Design Contest submissions.
        - Turbine Testing Contest winner: The team that earns the highest combined score in the Turbine Testing Contest.
        - Project Development Contest winner: The team that earns the highest combined score from all Project Development Contest submissions.
        - Connection Creation Contest winner: The team that earns the highest combined score from all industry and community engagement submissions.

[5] Should the venue change from CLEANPOWER, a decision will be announced by December 31, 2023. Teams are expected to provide their own travel funding to attend this event. Funding can come from prize winnings and other sponsorship.

2 Submission Requirements and Review Process

The CWC in its entirety consists of all the activities leading up to and during the final event. The final event is where the teams present their results from the four required challenges; the competing teams must have also submitted their written reports by the dates specified in this document.

While teams work on their submissions, faculty advisors, graduate student advisors, and members of industry secured by each team for support can provide feedback about the team's design so the students can identify mistakes, prove technical rigor, or demonstrate feasibility of their concept. Teams are highly encouraged to pursue mentorships and sponsorships early in the competition year; however, only undergraduate student team members may take an active role in any competition event. It is the role of the nonstudent team members, including mentors and sponsors, to provide a supportive environment and the educational background necessary for the students to achieve success in the competition. The Faculty Advisor advises, provides input, and coaches the students on the skills necessary to compete in the various aspects of the competition. **It is not appropriate for anyone other than an undergraduate student to be actively working on a wind turbine or making decisions.**[6] **Individuals other than undergraduate students actively working on the turbine or found making decisions will be asked to leave the competition premises.**

2.1 Submissions

The details of required submissions for each challenge are provided in the following sections and summarized below, including submission due dates. Refer to Appendix D for submission requirements and scoring, format requirements, and submission instructions. Teams are strongly encouraged to submit early in case of technical difficulties.

[6] Any student who was an undergraduate student member of the team during the competition year may continue to act in that role throughout the competition year.

Table 1. Submission Deadlines, Points, and Prizes

	Turbine Design (295 points)	Turbine Testing (380 points)	Project Development (350 points)	Connection Creation (225 points)
Phase 1: Application Selection Up to $2,000/team from a cash prize pool of up to $70,000	Deliverable outlined in Volume 1/Phase 1 of the CWC Rules document			
Phase 2: Midyear down selection Up to $15,000/team up to 12 teams from a cash prize pool of up to $180,000.	Design progress and prototyping to date	Prototype fabrication and testing video	Preliminary Project Development report	Outreach strategy and team story report
	Thurs., 12/14/23, 11:59 p.m. Mountain Time (MT)	**Thurs., 12/14/23, 11:59 p.m. MT**	**Thurs., 12/14/23, 11:59 p.m. MT**	**Thurs., 12/14/23, 11:59 p.m. MT**
Phase 3: Final Evaluation Up to $30,000 prize pool for winners as listed in Table 2 below.	Turbine design report	Timed assembly video Technical inspection	Project Development report	Metrics report
	Thurs., 4/18/24, 11:59 p.m. MT	**Thurs., 4/18/24, 11:59 p.m. MT**	**Thurs., 4/18/24, 11:59 p.m. MT**	**Thurs., 4/18/24, 11:59 p.m. MT**
	Turbine design question and answer (Q&A) supporting materials optional, poster (one total across all contests)	Test turbine and load system	Project Development presentation, poster (one total across all contests) and Q&A	Connection Creation presentation and Q&A, poster (one total across all contests)
	At competition	**At competition**	**At competition**	**At competition**

2.2 How Award Winners Will Be Determined

The Prize Administrators screen all submissions for completeness and, in consultation with DOE, assigns reviewers to independently score the applicable content of each complete submission. The reviewers will be comprised of federal and nonfederal subject matter experts with expertise in relevant areas. Reviewers will review submissions in each phase according to

the described evaluation criteria. The Prize Administrators will tally the scores based on the scoring criteria described.

Winners in Phase 2 will be determined based on the total points scored for the Phase 2 Midyear Project Submissions across all contests. Each contest includes a unique Phase 2 Midyear Project Submission, designed to award the student teams based on progress leading up to the final event and incentivize key aspects of the design. Up to 12 of the teams that score the highest on their Phase 2 Midyear Milestone Submissions will earn up to $15,000. Winners in Phase 3 will be determined based on the total points scored for both Phase 2 and Phase 3 submissions and testing. Final calculation of scores and determination of winners for Phase 3 is described in Table 3.

Final determination. The director of WETO is the judge of the competition and will make the final determination. Final determination of winners by the judge will take the reviewers' scores and program policy factors in Appendix L into account (see Table 2).

Table 2. How Award Winners Are Determined for the Phase 3 Grand Prize Awards

<table>
<tr><th>Award</th><th>Criteria*</th><th colspan="2">Prizes**</th></tr>
<tr><td>First Place</td><td>The team that earns the highest combined score in the Design, Testing, Project Development, and Connection Creation Contests</td><td>$10k</td><td rowspan="4">Trophy

Cash prizes will be paid to each winning team's institution.</td></tr>
<tr><td>Second Place</td><td>The team that earns the second-highest combined score in the Design, Testing, Project Development, and Connection Creation Contests</td><td>$7k</td></tr>
<tr><td>Third Place</td><td>The team that earns the third-highest combined score in the Design, Testing, Project Development, and Connection Creation Contests</td><td>$5k</td></tr>
<tr><td>Individual Contest Awards
Design Contest
Testing Contest
Project Development Contest
Connection Creation Contest</td><td>The team that earns the highest score in the associated contest</td><td>$2k each</td></tr>
</table>

*Specific details on earning points for each award are included in the following sections. The competition judge makes all final decisions in the allocation of prizes and awards.
**All participating teams in the final event receive a participation plaque.

3 Contest Submissions

CWC comprises four contests: Turbine Design, Turbine Testing, Project Development, and Connection Creation Contests. As this rules document reflects the submission requirements for both Phases 2 and 3 of the competition, each including a cash award, the following Sections 3.2 through 3.4 are organized by contest and explain the submission requirements for both phases within that contest.

All formatting requirements are detailed in Appendix D. Where relevant, each contest section lists page limits, restrictions on length of video that can be submitted, and number of supplemental images that will be accepted for each submission. Anything beyond the limits will not be considered during scoring. Submission materials and the potential point values for each phase are included in Table 3.

Table 3. Scoring Summary

Description	Possible Points
Presentation and Poster	
Turbine Design Contest	**295**
Phase 2 Midyear Milestone Submission	30
Phase 3 Final Turbine Design Submission	265
Turbine Testing Contest	**380**
Phase 2 Midyear Milestone Submission	30
Phase 3 Final Turbine Testing Submissions	50
Phase 3 Turbine Performance Testing	300
Project Development Contest	**350**
Phase 2 Midyear Milestone Submission	30
Phase 3 Final Project Development Submission	320
Connection Creation Contest	**225**
Phase 2 Midyear Milestone Submission	30
Phase 3 Final Metrics Report	60
Phase 3 Final Presentation	135
Total	**1,250**

3.1.1 Phase 3: Overall Competition Poster

As a requirement for all contests, teams must create a project poster that includes the Design, Project Development, and Connection Creation Contest activities. Teams are expected to have their posters on display at their team booth for the duration of the competition and will also likely be used as part of an industry-facing poster session. An easel and poster backboard will be provided for this purpose. Scoring for this poster is incorporated in the Design, Project Development, and Connection Creation Contest rubrics to ensure these project components are adequately represented, influencing the final score a team can earn in Phase 3. At the conclusion of the competition, team posters will be posted to the CWC website.

3.2 Turbine Design Contest

The Turbine Design Contest comprises two basic components: a single midyear submission and a final turbine design submission.

3.2.1 Phase 2 Turbine Design Midyear Milestone Submission

3.2.1.1 Design progress and prototype fabrication

A crucial part of designing and building any new system is having a viable concept that will meet the needs of the task. Finding such a concept involves having a deep understanding of the task to be accomplished and the physics of accomplishing that task along with a review of available resources (e.g., rules, OpenEI, webinars, past reports/designs). Brainstorming, high-level trade studies, and other methods can be used to narrow in on a concept that could be viable at this stage. Teams' thought process should include scoping out and ordering components to support prototype construction and testing. Deliverables include:

- Submit a one-page write-up that describes the concept the team has selected during the conceptual design process and summarize the progress made toward fabrication and assembly of a prototype. Students must define the required tasks that the turbine needs to accomplish to be successful. This is a short summary, so details are not needed at this time. Note that the elements presented in this submission need not be the same as the elements that survive to final delivery at the competition. It is more important to demonstrate the Team has started building, assembling, and testing than it is to make the design perfect prior to first prototype assembly.
- Scores will be based on how clear the concept is articulated, how likely it is to work for the tasks presented, and how much progress the team has made toward fabricating a prototype.

Table 4. Scoring Rubric for the Turbine Design Midyear Milestone Submission

Description	Possible Points
Design progress and prototype fabrication submission	
The concept is clearly articulated, detailing the progress made toward fabrication, assembly, and testing of a prototype	10
The proposed concept is likely to work well in achieving the student-defined tasks presented	10
The team has made sufficient progress toward fabricating a prototype, including ordering and assembling preliminary selected parts	10
Total	**30**

3.2.2 Phase 3 Final Turbine Design Submission

As a part of the final turbine design submission, teams will be required to develop a 15-page (maximum) technical design report, the overall competition poster described in Section 3.1.1, and a 10-minute presentation during the final event.

3.2.2.1 Technical Design Report

The technical design report explains the turbine concept development process from an engineering perspective. The report should detail the complete design process as it relates to the turbine being tested in the competition wind tunnel, as well as the foundation structure and its installation approach.

At a minimum, the report must include the following sections:

- **A cover sheet.** Begin the report with a one-page cover sheet that includes the team affiliation and contact information. It should indicate the team roles/hierarchy and approximately how many students, faculty, and others (e.g., sponsors, volunteers, and family members) are involved in the project.
- **A table of contents.**
- **An executive summary.** The executive summary discusses components from all sections of the report and includes a short, high-level description of the team project. Teams should use their judgment when deciding how long to make the executive summary; however, one page is often sufficient.
- **The technical design.** Teams should provide detail that is adequate for an engineering review of the baseline and operating properties of the turbine and its subsystems, including mechanical loading requirements, operational limits, control algorithms, and software. At a minimum, the following topics should be included in the prescribed order:
    - A description of the design objective and how the design components support this objective.
    - A clear and concise list of what is the same as submissions to prior competitions from the affiliated school, and why. This list should demonstrate an understanding of how previous research and design decisions have shaped the team's approach. If a team's school did not compete in a previous year's competition, they should write about how the information in last year's winning design report influenced their own design.[7]
    - A basic static performance analysis (e.g., C_P-Lambda report) of the turbine design that contains the annual energy production over a range of operational parameters.
    - A basic engineering diagram of all mechanical systems and an analysis of the expected mechanical loads and associated safety factors within the design, both for operational and parked conditions.
    - A basic engineering diagram of the foundation and a civil and structural analysis of the foundation and its anchoring system.
    - An electrical, one-line diagram of the overall system and electrical analysis comprising the generator model, power electronics (e.g., canonical model and one-line diagram), electrical load model, and operating voltage, including how the team plans to regulate voltage.
    - A control model analysis of the operational modes (i.e., the control states diagram and a description of primary operational modes).
    - Documentation of associated software architecture (e.g., data acquisition, turbine control, safety systems, states and state diagram, outputs to the turbine actuators,

[7] Winning reports can be found at: https://www.energy.gov/eere/collegiatewindcompetition/past-collegiate-wind-competitions

and data archiving) and its development. Note that this is about the development of the software itself, not the turbine control methodologies described previously.
    - A description of the final assembly of the wind turbine's subsystems. Where relevant, include how a distributed team environment was managed.
    - An assembly and commissioning checklist that can be followed during installation of the turbine in the wind tunnel to ensure it is functioning as expected before starting the scoring portion of the test. Note that this list should extend beyond a simple step-by-step assembly, and students should think carefully about how to ensure proper functionality of their turbine before commencing testing.
    - The results of laboratory and/or field testing of turbine prototypes.

This report should be no more than 15 pages in length and formatted according to the specifications provided in Appendix D. Pages submitted beyond this limit will not be reviewed. At the conclusion of the competition, team reports will be posted to the CWC website for reference during future events.

3.2.2.2 Presentation and Question and Answer Session

In addition to the written report, each team will present their design to a panel of reviewers followed by a question-and-answer (Q&A) session to answer any remaining questions that the reviewers may have from the written report. This presentation should begin with a brief overview that conveys the most important details of the technical design and clearly communicates the team's approach to design and development.

Presenters must be student team members and should showcase their wind turbine prototype and have the option to use posters, charts, PowerPoint slides, or other visual aids to engage with the reviewers and/or help clarify any questions the reviewers may have after reading the written report. Please bring necessary files on a USB drive along with any drivers needed to support presentation animation. Presentations are limited to 10-min, which will be followed by a 15-min Q&A period with the competition reviewers. Additional attendees are allowed in the feedback session as observers at the discretion of the student lead.

The reviewers will use the content from this project overview and Q&A period to make final adjustments to the technical design report score. Answers provided during the Q&A session will also be evaluated to gauge the depth of students' technical understanding of wind turbine design.

Table 5. Scoring Rubric for the Technical Design Competition

Description	Possible Points
Presentation, Q&A, and Poster	
The presentation is delivered clearly and professionally	20
Demonstrated understanding of technical design during Q&A session	30
Poster: Competition poster includes/represents this component of the competition in a well-designed, illustrative manner with efficient and effective use of text and graphics	20
Subtotal	**70**
Final Report	
Concise, readable, and descriptive with logical flow and clear communication	15
Comprehensive design objective description for test turbine and foundation	15
Clear and concise enumeration of what elements of their technical design are the same as last year, why,[a] and what has changed from the previous year	15
Thoroughness and validity of the static performance analysis	15
Quality and clarity of the mechanical loads analysis and associated safety factors of structures	15
Clear description and analysis of the underwater structure and anchoring system	15
Clear description of the electrical system design choices and analysis of its performance	15
Quality and clarity of the engineering diagrams including mechanical and electrical drawings	15
Quality of controls analysis including states and algorithms	15
Comprehensiveness of software implementation and testing description including how it was developed and tested	15
Documentation of final assembly including how things go together, stay together, and are adjusted in tunnel testing	15
Completeness of commissioning checklist with logical flow	15
Quality of laboratory and/or field-testing process	15
Subtotal	**195**
Total	**265**

[a] **Teams whose schools did not compete last year should write a few sentences about how the winning design report from last year influenced their design decisions instead.**

3.3 Turbine Testing Contest

The wind turbine testing contest is comprised a midyear milestone submission, a final turbine testing submission, and a series of individual turbine tasks.

3.3.1 Phase 2 Midyear Turbine Testing Milestone Submission

3.3.1.1 Prototype Fabrication and Testing Video

This competition has a strong hands-on component. As such, it is important to make early progress toward tangible components and working systems. Building small test models and executing individual component tests can be very instructive in the overall design process and allow the team to get a strong feel for what works and what does not. It is important to build early and iterate on a design as things rarely work perfectly the first time. Learning how those individual components interact with each other is also critical.

To ensure teams are successful in meeting this goal, specific submission requirements for the Turbine Testing Contest Midyear Milestone Submission include:

- Submitting a 5-minute video that describes the team's progress to date on a working prototype. The video need not demonstrate a complete working system although it can if the team has made that much progress. Early-stage component prototypes are also encouraged. Details should be presented on how those components are being tested and evaluated for functionality in the greater design. Note that the elements presented in this submission need not be the same as the elements that survive to final delivery at the competition. It's more important to get started building, assembling, and testing than it is to make the design perfect prior to first prototype assembly.
- Scores will be based on how clear the concept is articulated, how likely it is to work for the tasks defined by the students in conceptual design, and how much progress the team has made toward fabricating a prototype.

Table 6. Scoring Rubric for the Turbine Testing Midyear Milestone Submission

Description	Possible Points
Prototype fabrication and testing video	
The concept is clearly articulated, detailing the progress made toward fabrication, assembly, and testing of a prototype	10
The proposed concept is likely to work well in achieving the student-defined tasks that are presented	10
The team has made sufficient progress toward fabricating a prototype, including ordering and assembling preliminary selected parts	10
Total	**30**

3.3.2 Phase 3 Final Turbine Testing Submission

As a part of the final turbine testing submission, teams will be required to develop a timed assembly video, conduct a technical inspection prior to the competition, and create the overall competition poster described in Section 3.1.1.

3.3.2.1 Timed assembly video

A new element for this year is a timed assembly procedure at competition. To ensure teams are ready to meet this challenge, a timed assembly video must be provided for review. This video will show the same assembly elements that will be timed at the competition, and must include everything from after the foundation has been installed and aligned and the stub placed on top by the competition staff up until the team declares they are ready for testing. The teams will be given 3 min for this task at competition plus an additional 3 min for turbine commissioning. For this reason, this video submission must be exactly 3 min or less in length, uncut, and showing the turbine assembly in real time.

3.3.2.2 Technical Inspection Prior to Competition

To test at the final event, teams will be required to pass a technical inspection. To make this process as smooth as possible, the prize administration team requires that student teams go through a practice inspection prior to the competition, working with someone who is as qualified to interpret the rules and understand the competition as best as possible. Ideally, this person

should be someone other than the faculty advisor to provide a fresh perspective at the end of the year. As part of the tech inspection process, each team must:

- Submit a short write-up summarizing the qualifications of the inspector, certify that both the student team and inspector have read Appendix A, and include a signed tech inspection sheet that includes all of the inspection points listed in Appendix E.
- Detail any deficiencies and plans on how to remedy those deficiencies before competition.
- **New for this year: include images of your cables and cable connectors along with specification sheets for the connectors showing that you have met the rules (e.g., no single-strand cables, Powerpoles are the correct polarity, and all connectors are quickly connectable).**

Scores will be based on the completeness of this inspection, not on whether the system passes all elements. The purpose of the inspection is to identify areas that would not pass technical inspection at the competition, thus giving the teams time to correct these deficiencies before the competition begins.

Table 7. Scoring Rubric for the Final Turbine Testing Submissions

Description	Possible Points
Timed assembly video	
The video is 3 minutes in length or less	5
The video is in real time with no cuts and acceptable production quality	5
The video shows the assembly of all turbine elements as specified	15
Subtotal	**25**
Technical inspection prior to competition	
Includes inspector qualifications and rules review certification	5
Lists deficiencies and planned remedies, if any	5
Includes images of cable connectors and specification sheets. Cable and connectors comply with the rules	5
Inspection is complete and thorough	10
Subtotal	**25**
Total	**50**

3.3.3 Phase 3 Turbine Performance Testing

Testing provides teams with the opportunity to demonstrate their wind turbine's performance through objective tasks, and the testing outcomes help determine if they succeeded in developing a durable, safe, high-performing machine. Performance is a strong indicator of a turbine's ability to compete successfully in the marketplace.

Each turbine, along with its corresponding load system, will be tested in the competition wind tunnel. The contest will include the following tasks: turbine performance, controllability, safety, foundation success, structure weight, and durability over a range of wind speeds along with foundation performance. This section describes the requirements of the individual tasks in which the turbine is expected to perform, the parameters of the testing conditions, and details on scoring algorithms and point allocations between individual tasks.

Students will use their load for all tasks. Although the prescribed order will be the same for each team, the exact amount of time at each set point could vary between schools. Thus, teams are expected to design their turbines to sense the local conditions within the tunnel and react accordingly for each task.

Table 8. Scoring Summary for Wind Turbine Performance Testing

Description	Possible Points
Power curve performance task	50
Control of rated power and rotor speed task	50
Safety task	50
Foundation success task	50
Durability task	60
Structure weight	40
Total	**300**

3.3.3.1 Power Curve Performance Task

The objective of this task is to test each wind turbine over a range of wind speeds to determine a power curve. It is meant to be a direct comparison of power performance between turbines, which is one factor by which real wind turbines are evaluated.

Each turbine will be tested at integer wind speeds between 5 and 11 m/s inclusive for a duration of 60 seconds (s) or less, with the stated intent of obtaining a "stable" power reading. A "stable" power reading is defined as stable rotations per minute and stable power per electronic testing device during the test period. As power output may fluctuate, for the purposes of this task, the allowable power outputs to be included in the maximum average power (per electronic testing device) during any 5-s interval will be defined as ±10% of the maximum average power.

This stability criterion will also consider any noise that the data acquisition system measures. The system samples at 50 kilohertz using a filter with a cutoff frequency of 22.5 kilohertz. These samples are then block-averaged down to 200 hertz. To meet the specified stability tolerance, teams should ensure that any noise in the power their turbine produces is adequately filtered and that the combination of power variation and measured noise is within the specified tolerance when read by the competition data acquisition system. One way to reduce noise is to implement an LC filter (inductor-capacitor filter) on the power output lines to filter noise coming from the switching of power electronics.

A total score for this task will be calculated according to Table 9 by multiplying each power measurement in watts in 1-m/s wind speed intervals from 5–11 m/s by the factor given. If power is not stable within the specified tolerance, the score for the bin will be zero.

Table 9. Weighting for the Power Curve Performance Task

Wind Speed (meters/second)	Factor
5	0.7
6	0.8
7	0.8
8	0.7
9	0.4
10	0.3
11	0.1

3.3.3.2 Control of Rated Power and Rotor Speed Task

Wind turbines must withstand high winds without damaging their mechanical or electrical components. Because wind power is proportional to the cube of wind speed, the energy available in the wind quickly becomes very high as wind speed increases. To control rising mechanical and electrical loads, turbines must be able to limit their rotational speed and output power in these high-wind conditions. Proper controls can also be used to limit rotor thrust and, therefore, the moment applied to the tower and foundation system.

In this task, each turbine will be subjected to one wind speed bin chosen by the organizers between 12 m/s and 14 m/s (inclusive) and turbine performance in that bin will be compared to the performance in the 11-m/s bin. The turbines are expected to keep the rpm at or below the rpm determined at 11 m/s and to keep the power at the same level as is determined at 11 m/s.

Scores for power will be calculated according to the following:

$$r_p \equiv \frac{measured\ power\ in\ bin\ of\ interest}{measured\ power\ at\ 11\ m/s}$$

$$Bin\ Score = 25\frac{\left[\tanh\left(-20 * \left|r_p - 1\right| + \pi\right) + 1\right]}{\left[\tanh\left(\pi\right) + 1\right]}$$

In Figure 1, a ratio, r_p, of 1.000 represents perfect power control at the same value that was measured in the 11-m/s bin. The weighting shown will be multiplied by 25 for the selected bin to obtain a score.

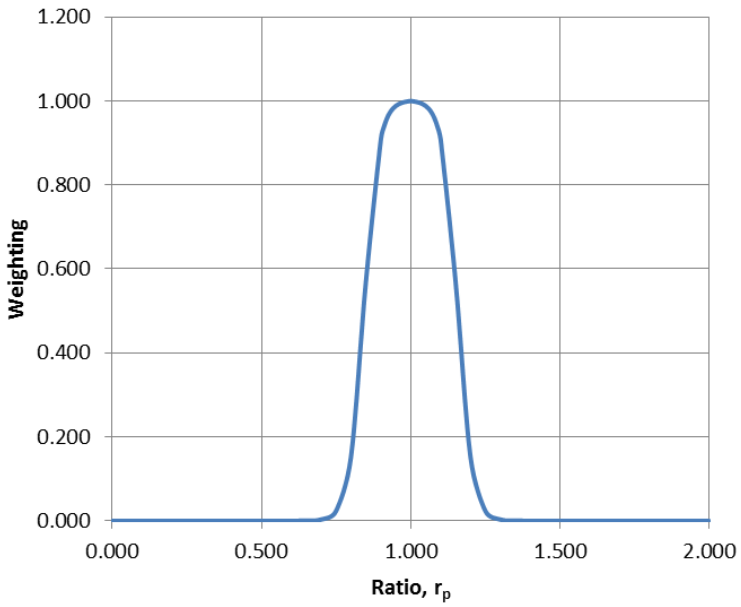


Figure 1. Score weighting based on power ratio for control of rated power task

Scores for rotor speed control will be calculated according to the following:

$$r_s \equiv \frac{measured\ speed\ in\ bin\ of\ interest}{measured\ speed\ at\ 11\ m/s}$$

$$0 < r_s < 1.03 \rightarrow Bin\ Score = 25$$

$$r_s \geq 1.03 \rightarrow\ Bin\ Score = 25\frac{[\tanh\left(-20 * |r_s - 1.03| + \pi\right) + 1]}{[\tanh\left(\pi\right) + 1]}$$

In Figure 2, a ratio, r_s, of 1.000 represents the perfect rotor speed control at the same value that was measured in the 11-m/s bin. The weighting shown includes a 3% buffer above and infinite buffer below that speed to obtain full points. The weighting shown will be multiplied by 25 for the selected bin to obtain a score.

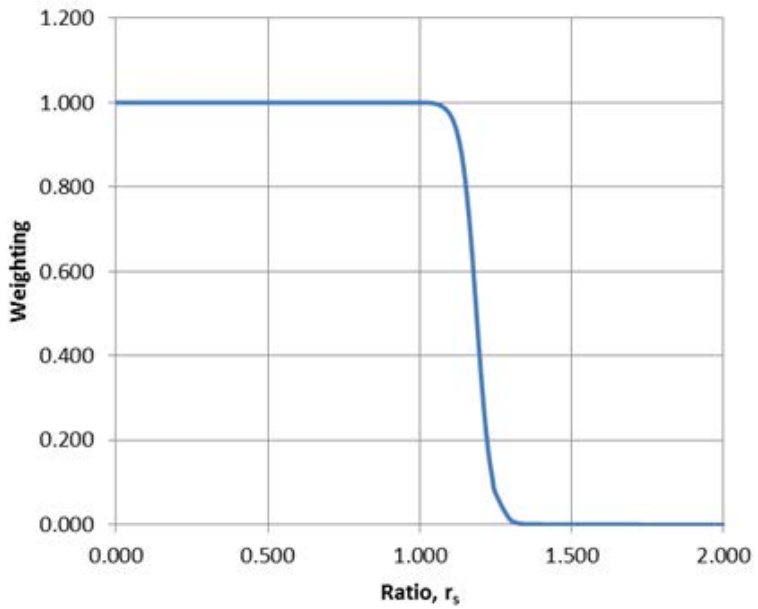


Figure 2. Score weighting based on revolutions per minute ratio for control of rated rotor speed task

3.3.3.3 Safety Task

Safety is of the utmost importance to wind turbine designers and manufacturers. To be certified, turbines must be able to safely shut down rapidly and with a fail-safe shutdown capability. Turbines must shut down when disconnected from the grid, as well as manually upon command. Each team may choose to address these shutdown scenarios with one or two systems or mechanisms.

In this task, the turbine will be required to safely shut down[8] at two different times during the testing period at any wind speed, up to the maximum continuous operational wind speed specified in Appendix A: Turbine and Load Design Requirements. For each turbine, the shutdown process will be initiated once "on command" and separately by disconnecting the load from the point of common coupling. It is important to note that the open-circuit voltage of the wind turbine will be monitored during this shutdown and not exceed the limit provided in Appendix A: Electrical Requirements.

The safety task is scored on a pass/fail basis in two parts. If the wind turbine achieves a successful shutdown upon manual initiation, the team will receive 15 points. If it automatically restarts, the team will receive an additional 10 points. If the team must manually restart the turbine, they will receive zero points for the restart. If the turbine achieves a successful shutdown when disconnected from the load system, the team will receive an additional 15 points. If the turbine automatically restarts when reconnected, the team will receive an additional 10 points. If the team must manually restart the turbine, they will receive zero points for the restart.

[8] For the purposes of this task, "shutdown" is defined as dropping below 10% of the maximum 5-second bin average rotations per minute achieved during power performance testing. This reduction in rpm must occur within 10 seconds and remain below the limit indefinitely until the shutdown condition is removed.

The wind turbine must also be able to restart at any wind speed above 5 m/s. If the turbine fails to successfully restart, the team may work on their electronics to manually restart their turbine, resulting in a zero score for the restart portion of the task. The manual restart, if necessary, will occur with the tunnel running at 8 m/s.

3.3.3.4 Durability Task

Wind turbines are expected to perform over the long term and will be subjected to a wide variety of weather conditions. Producing power effectively and over the course of the turbine's lifetime are desirable design qualities.

In this task, each turbine will be subjected to the same prescribed variable wind speed. This test helps verify that the turbine can function over a wide range of operating conditions. The 5-minute testing period for this task will be divided into two parts:

The first part will encompass the first 3 min, during which the wind speed will be kept between 6 m/s and 14 m/s. The second part will encompass the final 2 min, during which the wind speed will be kept between 8 m/s and up to a maximum of 22 m/s.

This portion of the task will be scored on a second-by-second basis for the first 3 min. Each 3-s period during which the turbine system produces positive power for the first 3 min of the task will result in 1 point being awarded for a maximum of 60 points. The turbine need not produce power during the second portion of this task; no score will be awarded for power production, but it will be subjected to higher wind speeds, allowing teams to gather more points in the foundation success task.

Teams have the option to "opt out" of the second period of the testing; however, opting out will result in lower scoring potential for the foundation success task because the highest wind speeds are experienced in the second period.

3.3.3.5 Foundation Success Task

The foundation's purpose is to keep the turbine stationary during the entire period of testing. However, the wind tunnel does have a "hard stop" that will prevent the top of the competition-provided adapter stub from moving beyond a certain point. If the foundation fails to keep the turbine stationary, it will usually fall all the way to the hard stop.

This task will be scored according to whether the foundation tips beyond a set limit during testing (see Appendix A: Physical Design Constraints Within the Tunnel), taking into account the highest wind speed that was experienced before tipping occurs. Points will be awarded linearly from 0 to 50 based on the maximum wind speed attained from 5 m/s to 20 m/s, with 20 m/s being worth 50 points and 5 m/s being worth 0 points. No more than 50 points or less than 0 points can be earned for this task.

3.3.3.6 Structure Weight Task

This portion of the competition will be scored based on the weight of the in-water support structure as it relates to the weights of the structures of the other teams. All structures will be weighed dry, including all necessary installation hardware (not including tools), and the results will be ranked with the lightest foundation getting the highest score. The following formula will be used to calculate each team's point total for this section of the contest:

$$Score = 40 - 2 \times (rank - 1)$$

3.4 Project Development Contest

The Project Development Contest is a yearlong effort to investigate key aspects of wind farm siting and project development activities. This could include understanding wind resource data and performance estimation, factors that affect project economics, bathymetry, environmental issues, transportation constraints, transmission design, permitting requirements, turbine technology, and performance variables (e.g., wakes, turbine availability, and site-specific losses).

For this contest, teams must assess wind farm development opportunities within the defined project area, which for CWC24 includes two of the Great Lakes (see Appendix B for more information), create a rough development plan, and prepare a bid for a lease area (one or more lease blocks) within the project area. Team members must be prepared to explain their process to reviewers at the competition.

New this year, teams must incorporate at least one other generation, storage, or end-use technology as part of the offshore-wind-based hybrid power plant. Consideration of technical integration requirements and risks, such as storage and transport, is required. Consideration of market participation or alternative offtake agreements with surrounding industry, such as hydrogen use in local steel production, is highly encouraged. Including policy factors, such as production tax credits, and benefits to the local community[9] are also highly encouraged.

As part of this contest, there is a midyear submission and a final deliverable. The following describes the procedure for developing the site plan and preliminary wind farm design, reflective of the information needed to complete both submissions.

1. Select a specific lease area within the area discussed in Appendix B. Teams should:
    - Be prepared to explain how and why their lease area was chosen.
    - Include some considerations, such as wind resource, bathymetry, geotechnical data, lease boundary, access to transmission, transportation access, and environmental factors.
2. Develop a preliminary wind farm design. This should include:
    - Research site characteristics, such as:
        - Wind resource information, bathymetry data, roughness, water depth, geotechnical data, significant wave height, hurricane impacts, port infrastructure, lake activities (e.g., fishing, shipping, military), and so on.

[9] https://www.energy.gov/diversity/justice40-initiative

    - Sensitive species in the area, sensitive ecosystems, impacts to wildlife, and mitigation options, if relevant.
- A draft preliminary design that includes:
    - Wind turbine type, hub height, rotor diameter, and number of turbines
    - Foundation type
    - Interconnection site on the coast
    - Staging, construction, and operations and maintenance ports
    - Survey, installation, and operations and maintenance vessels
    - The project boundary.

3. Conduct a cost-of-energy and cash flow analysis for the 20-year expected life of the project. The analysis should, at a minimum, consider each of the following elements:
    - **Initial capital cost.** This covers costs associated with development, turbine procurement/installation, and balance of station. Costs include, but are not limited to, site preparation; wind turbines; foundations; electrical hardware; electric collection system and transmission lines; substation equipment; wind farm control and monitoring equipment; operations and maintenance facilities and equipment; shipping; resource assessment; preconstruction environmental monitoring; surveying; legal counsel; project management; permits; construction insurance; title insurance; lease payments; engineering services; sales and use tax. Costs must be expressed in dollars and dollars per kilowatt.
    - **Annual operating expenses.** Key cost categories here include operations and maintenance costs (including preventative maintenance, corrective maintenance, and spare parts), lease costs, asset management, operational insurance, and scheduling fees. Teams should consider the potential of increased costs year over year. Costs should be expressed in dollars and dollars per kilowatt per year.
    - **Annual energy production.** The total amount of electrical energy the wind farm expects to make in a year, expressed in megawatt-hours.
    - **Market conditions.** The team should research what the market is willing to pay for the megawatt-hours produced and compare this with the cost of energy.
    - **Financing plan.** Some elements the team should consider include construction financing; tax equity; sponsor equity; permanent (long-term) debt; financing fees; debt and equity return requirements; depreciation; and income tax.
    - **Incentives.** This includes national incentives, tax credits, and any regional incentives. The team should research potential abatements sales and use tax.

Note: Steps 2 and 3 may require several iterations to balance financial and technical elements.

4. Finalize detailed design of the site plan, including the following steps:
    - Finalize wind turbine locations, turbine type, rotor diameter, and foundation type
    - Finalize transmission design from project to point of interconnection
    - Plan port activities
    - Plan submerged land leases.

The final design does not need to remain the same as the preliminary design proposed in the submission.

5. Propose a bid price, as follows:
    - Teams should propose a maximum bid price they would be willing to pay for their chosen lease area. This bid should be based on the cost of energy and cash flow analysis developed in Step 3.

3.4.1 Phase 2 Midyear Project Development Submission

3.4.1.1 Preliminary Project Development Report

The midyear submission should describe activities completed in Steps 1 and 2 in a short report that is no more than five pages and formatted according to the specifications in Appendix B. The deadline is listed in Section 2.1.

This report may also be used as part of the final report for this contest.

Table 10. Scoring Rubric for the Midyear Progress Submission for Project Development

Description	Possible Points
Preliminary site selection and down-select, including identifying potential siting challenges and opportunities associated with options, are adequately represented in the submission.	15
The ancillary benefits that the particular site can produce are adequately represented in the submission.	15
Total	**30**

3.4.2 Phase 3 Final Project Development Submissions

As a part of the final project development submission, teams will be required to develop a final Project Development report, a presentation, and an overall competition poster (described in Section 3.1.1).

3.4.2.1 Project Development Final Report

The Project Development report is the primary means for a team to provide detailed information about the project to the reviewers, given that the reviewers have a limited opportunity at the competition event to evaluate the yearlong project development activities.

At a minimum, the report must include the following sections in the prescribed order and represent all five steps mentioned in the project development process:

- **A cover sheet.** Begin the report with a one-page cover sheet that includes school affiliation, contact information, project name, team roles/hierarchy, and approximately how many students, faculty, and others (e.g., mentors, sponsors, or other volunteers) are involved in the project.
- **A site description and energy estimation.** This should include information about the wind resource, site layout, wind turbine type, foundation, sensitive environmental regions and species, reason as to why this site was selected, and risks and fatal flaws (i.e., fatal flaw being circumstances that can lead to the project's demise).

- **Financial analysis.** This section should outline the financial potential of the project, noting required capital, financing, and key assumptions (e.g., project marginal costs). The team should demonstrate the path to solvency and outline the project's potential through cash flow analysis. Full pro formas (pro formas being financial statements forecasted for future periods typically used for Security and Exchange Commission filing) are not required; however, it is recommended that higher-level, longer-term summaries be included to communicate the attractiveness of the project for investment.
- **Discussion of optimization process.** This section should describe the iterative process of optimization that occurred between the preliminary site design and the financial analysis.
- **A bid for a lease.** The team should suggest the maximum bid they would be willing to pay for their chosen lease area.

The report should be no more than 15 pages in length and formatted according to the specifications laid out in Appendix D. Pages submitted beyond this limit will not be reviewed.

At the conclusion of the competition, team reports will be posted to the competition website for reference during future events.

3.4.2.2 Presentation

At the competition, teams will present their proposed wind farm site plan during an assigned presentation session with the reviewers who will represent potential project owners or investors. This presentation should convey the most important details of the project, which may include items from the Project Development report. Slides are required.

The teams will have 15 min to present their project and another 10 min for questions from the reviewers.

Table 11. Project Development Contest: Develop Plan for Hypothetical Project

Description	Possible Points
Presentation and Poster	
The presentation is delivered clearly and professionally	35
The competition poster includes/represents this component of the competition in a well-designed, illustrative manner with appropriate use of text and graphics	25
Subtotal	**60**
Final Report	
The written report is concise, readable, and descriptive with logical flow; communicates technical information clearly	35
Wind farm design includes a detailed layout and resource assessment	30
Environmental impacts and mitigation approaches are clearly articulated	25
Levelized cost of energy (cost/kilowatt-hour) is realistic and adequately justified	20
Balance-of-station elements are adequately represented and considered in the financial analysis (capital expenditures)	25
Evaluation of annual operational costs (operational expenditures) are fully presented and adequately justified	25
Financial plan and bid price are fully presented and adequately justified	30
Understanding of market opportunities and constraints (e.g., power markets, equipment supply chains, ownership structures, taxes, policies, and incentives) are portrayed fully with adequate justification	35
Logical and consistent inclusion of hybrid opportunities and ancillary benefits are included and adequately justified	35
Subtotal	**260**
Total	**320**

3.5 Connection Creation Contest

The Connection Creation Contest is designed to forge stronger connections between competition participants, the wind industry, students, and the team's local community.

This contest includes activities that allow for maximum impact between the teams and their surrounding communities and stakeholders while informing the other competition contest elements to the extent possible.

As part of this contest, there is a midyear submission and a final deliverable.

3.5.1 Phase 2 Midyear Connection Creation Milestone Submission

3.5.1.1 Outreach Strategy and Team Story Report

The midyear submission must encompass the team's outreach goals, recruitment, and social media strategies, and their plan for achieving these goals, in a short report that is no more than five pages and formatted according to the specifications laid out in Appendix D. The deadline is listed in Section 2.1.

The report should include an outreach timeline chronicling the team's proposed activities and associated announcements throughout the year. An outreach plan is an industry best practice to help keep announcements on track and serve as an activity road map.

This report must also include background on the team. Organizers will post excerpts from these reports as the team stories on the CWC website and may edit the text for consistency between teams and to meet necessary web standards on energy.gov. Teams are encouraged to promote their team stories through their social media channels and media connections once they are live on the CWC website.

This report should include:

- Team name, institution name, city, and state
- Faculty advisor and student lead names and email addresses
- Why the team is participating in the CWC and what the team is most excited for in this competition
- The team's vision for a clean energy future
- High-level goals the team aims to achieve with their outreach activities that include but are not limited to:
  - Raising student and local community awareness of wind energy
  - Inspiring and recruiting new students to participate in the CWC and diversifying the team
  - Educating and exciting young students about opportunities in wind energy
  - Highlighting skills developed during the competition
- The team's history and lessons learned from previous years, or how new teams got involved and initiated
- Team structure, including if it is a club team, capstone, or other; and student leadership roles
- The team's recruitment strategy, including what steps have been taken to ensure diversity and inclusivity on the team
- The team's strengths and strategies for success
- Any industry connections or partnerships that the team has (including alumni), and how the team will leverage these connections to achieve their outreach goals
- The team's social media and communications strategy, including team social media accounts with hyperlinks, and relationships developed with the team's school newspaper or local media outlets
- Details on each of the team's three chosen Connection Creation Contest activities (see details in Appendix C), including how these activities will help the team achieve their outreach goals and their plan for executing these activities.
  - If the team has chosen to complete the Understanding the Wind Industry activity, they must include preliminary contacts for the interviews or how the team will find these contacts
- A timeline for the contest elements presented in chart form (see the engagement toolkit for an example), including:
  - Timeline for proposed events or interviews
  - Planned outreach announcements and social media posts
- Up to 10 photos or social media images that have been developed for outreach purposes
- A team photo, including the names of the team members in the order in which they appear. Students in the photo should be following practices consistent with local

social distance and mask guidelines when the picture is taken, if applicable. This photo must be submitted as a separate .jpg or .png file in addition to being included in the report.

The Outreach Strategy and Team Story Report should be in one document and not exceed five pages (photos are not included in the page count). Formatting details can be found in Appendix D. The deadline is listed in Section 2.1.

Table 12. Scoring Rubric for the Phase 2 Midyear Connection Creation Submission

Description	Possible Points
Quality and creativity of outreach activities as represented in the Outreach Strategy Report	10
A clear strategy and direction and discussion of proposed impact as a result of the three activities selected	10
Quality and informativeness of team story with engaging and creative storytelling	10
Total	**30**

3.5.2 Phase 3 Final Connection Creation Submissions

As a part of the final Connection Creation Contest submission, teams will be required to develop a final metrics report, presentation, and the overall competition poster described in Section 3.1.1.

3.5.2.1 Final Metrics Report

Teams will submit a final report detailing the metrics of their Connection Creation Contest activities throughout the year. This report should include the following:

- Recruitment strategy outcomes, including:
  - Metrics on team breakdown and recruitment, including:
    - Team numbers and growth
    - Grade levels of team members
    - Composition of the team's university overall and of the team (e.g., race, gender)
    - Breakdown of majors in the team
  - Reflection on the team's original recruitment plans versus results attained
- Social media strategy outcomes, including:
  - Metrics on social media account growth, including for each platform:
    - Number of followers
    - Number of posts and likes
    - How those numbers grew throughout the year
  - Reflection on the team's original social media plan versus results attained
- Each of the team's three chosen contest activities, including:
  - Metrics on each activity, including:
    - Number and types of events or interviews
    - Numbers of team and participant attendance
  - Reflection on how each activity met the team's high-level outreach goals.

    - If the team has chosen to complete the Understanding the Wind Industry interviews, provide contact information for each interviewee, including:
        - Full name, company affiliation, and email address
        - Origin of the relationship (i.e., professional or alumni)
        - Sector in the wind energy industry
        - Response regarding if this person would be open to continued participation in future CWC events
- Teams may include up to 20 photos or social media images that depict their outreach activities.

This report should be no more than four pages in length (photos are not included in the page count). Formatting details can be found in Appendix D. Reports from each of the teams will be published on the competition website, used for reference for future events, and could be used to develop future competition submissions.

Table 13. Scoring Rubric for Final Metrics Report

Description	Possible Points
Final Metrics Report	
Written report: concise, readable, and descriptive with logical flow; communicates information clearly	15
Quality of recruitment plan metrics and demonstrated understanding of impact	15
Quality of social media metrics and demonstrated understanding of impact	15
Quality of activity metrics and demonstrated understanding of impact	15
Total	**60**

3.5.2.2 Final Presentation and Q&A

Teams must develop a final PowerPoint presentation to share their progress on each competition element throughout the year. This presentation must include the following:

- Details on the outreach strategy, including the team's initial high-level goals
- Details on the team's recruitment strategy and execution
- Details on the team's social media strategy and execution
- Each of the team's three chosen contest activities, including the goals of each activity, planning and execution, and an assessment of activity impact.

Teams should emphasize the quality and visual appeal of each slide and the accompanying presentation by the speaker. Slides should include high-resolution photos to represent each contest element. Teams may use videos, but this is not required. See Appendix D for instructions on submission and formatting details.

Each team will have 10 minutes to present to a panel of reviewers and to the public. This will be followed by 10 minutes of questions from the reviewers. Teams will be scored on the professional and clear structure of the presentation, use of effective storytelling techniques and visual elements, and their completion of each of the required submissions.

Table 14. Scoring Rubric for Connection Creation Contest Final Presentation and Poster

Description	Possible Points
Final Presentation	
PowerPoint is concise and visually engaging, and presentation to reviewers is professional and clear, uses effective storytelling techniques	15
Demonstrated execution of outreach plan and team goals, including improvement in digital public engagement (social media or other news outlets)	20
Execution and demonstrated impact of chosen activity #1	15
Execution and demonstrated impact of chosen activity #2	15
Execution and demonstrated impact of chosen activity #3	15
Successful recruitment and inclusion of a multidisciplinary team with diverse backgrounds	15
Diversity of outreach methods and creativity in tactics used	20
Poster: includes/represents this component of the competition in a well-designed, illustrative manner with appropriate use of text and graphics	20
Total	**135**

Appendix A. Turbine Design and Testing Contest Specifics

Turbine and Load Design Requirements

Each team will design and build a prototype wind turbine. It must be designed to withstand continuous winds of up to 22 meters per second (m/s) at sea level. Each prototype must also be designed for testing inside the Collegiate Wind Competition wind tunnels (further designated as "tunnel[s]" or "wind tunnel[s]").

Specifications for Competition Tunnel

A digital rendering of the competition tunnel is shown in Figure A-1. The dimensions of the test chamber are 122 centimeters (cm) wide by 122 cm high by 244 cm long. There are inlet and outlet components of the wind tunnel that extend beyond the test chamber. The tunnel has a drawdown configuration; that is, the air is sucked through the test section—entering at the left, exiting at the right—with the drawdown being induced by the fan on the right side of the tunnel. A honeycomb flow straightener at the inlet of the wind tunnel provides for near-uniform mixing of the incoming air. There is a debris filter upstream of the fan section. The screen is made of wire mesh to prevent wind turbine pieces from getting sucked into the fan unit.

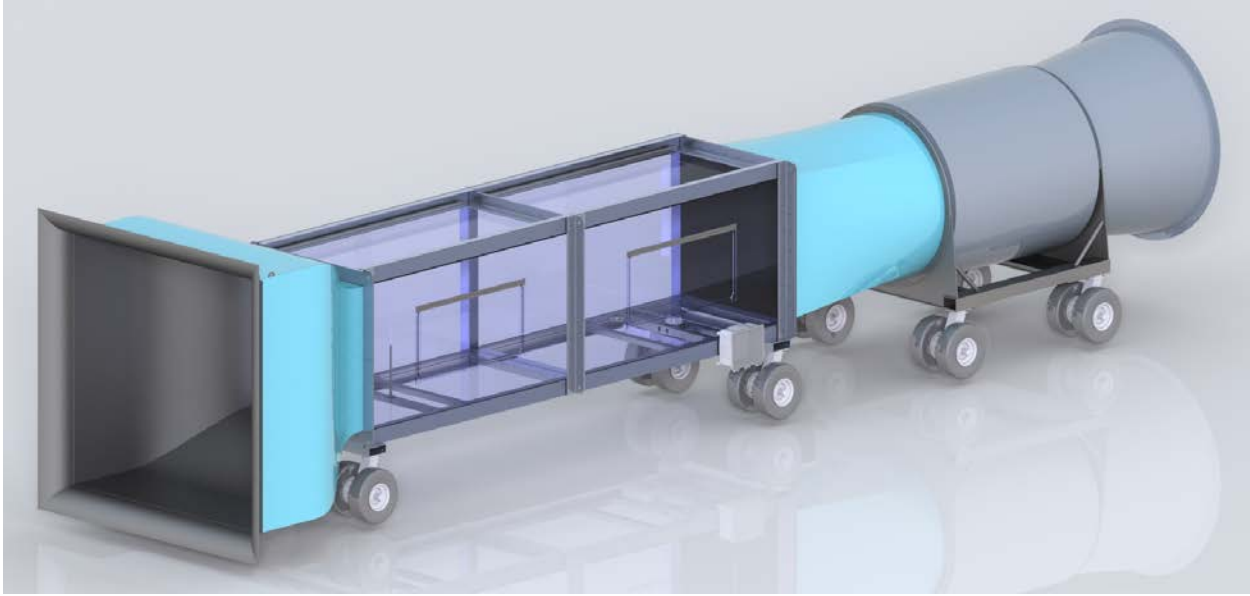


Figure A-1. The configuration of the Collegiate Wind Competition wind tunnel. ***Image created by Jason Roadman, National Renewable Energy Laboratory (NREL)***

Physical Design Constraints Within the Tunnel

At zero yaw angle, the entire wind turbine must fit within the volume specified and shown in Figure A-2. The turbine must have the following maximum geometry:

- Rotor and nonrotor turbine parts must be contained in a 45-cm-by-45-cm-by-45-cm cube. This cube may be shifted as much as 10 cm fore or aft of the tower centerline when the turbine is aligned with the flow.

- A 15.8-cm-diameter cylinder centered on the mounting flange extending from the tunnel floor to the bottom of the previously mentioned cube can contain only nonrotor turbine parts. For this purpose, these parts will be defined as anything that does not capture energy from the moving air, including the mounting flange.
- All turbines must fit through the 61-cm-by-122-cm turbine door in one assembly with no additional assembly occurring inside the tunnel other than attachment to the base flange and connection to external electrical components. Electrical connections should not be made in the nacelle during installation.

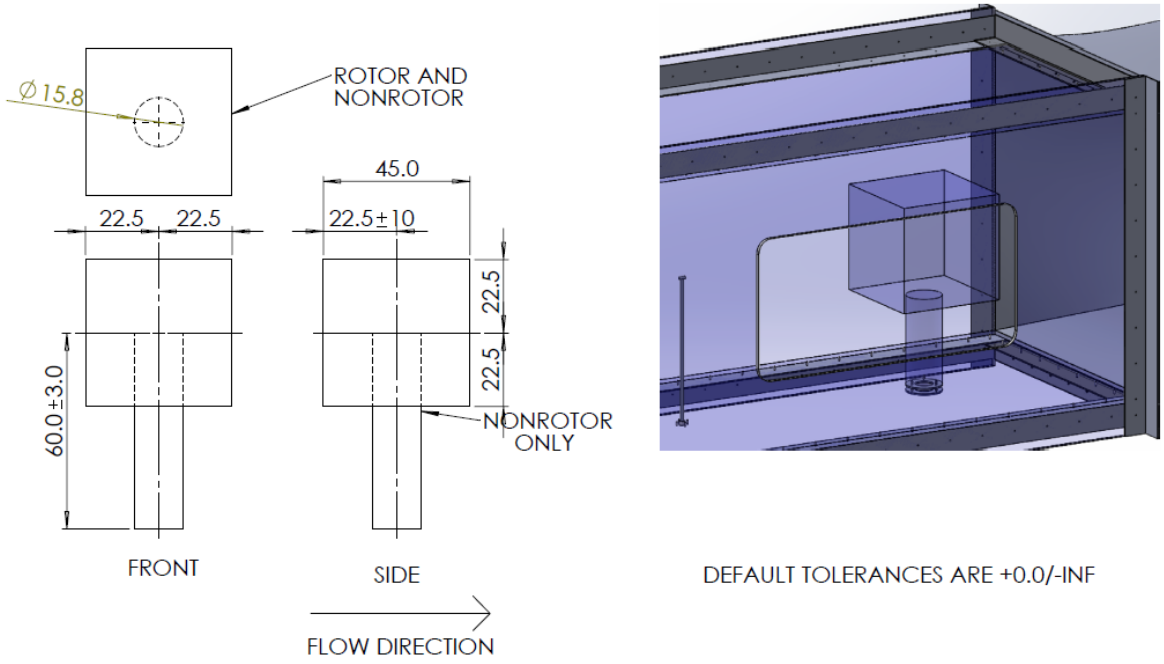


Figure A-2. Allowable turbine volume. ***Image created by Jason Roadman, NREL***

The foundation of the wind turbine system must adhere to the following:

- **The foundation structure and anchorage will be a primary focus of the competition.** Students must design a structure to be installed in a water tank with a sand bed to simulate shallow-water, fixed-bottom offshore foundations. This foundation structure will be the sole support for the wind turbine. See Figure A-3, Figure A-4, and Figure A-5.

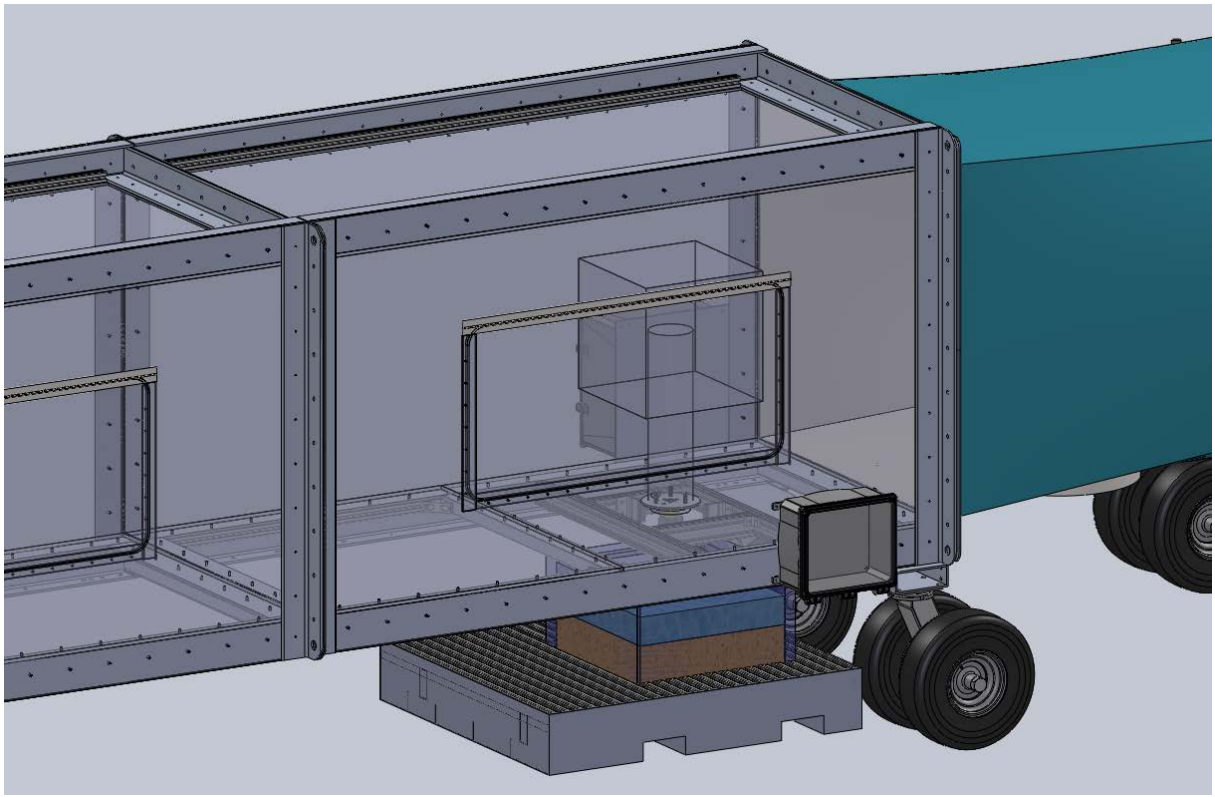


Figure A-3. Offshore simulation tank underneath the competition wind tunnel. ***Image created by Jason Roadman, NREL***

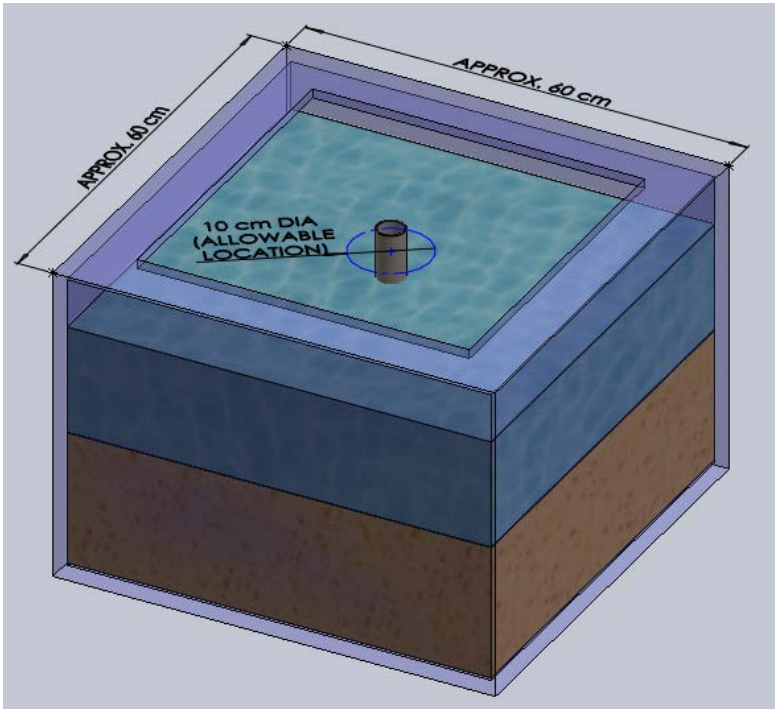
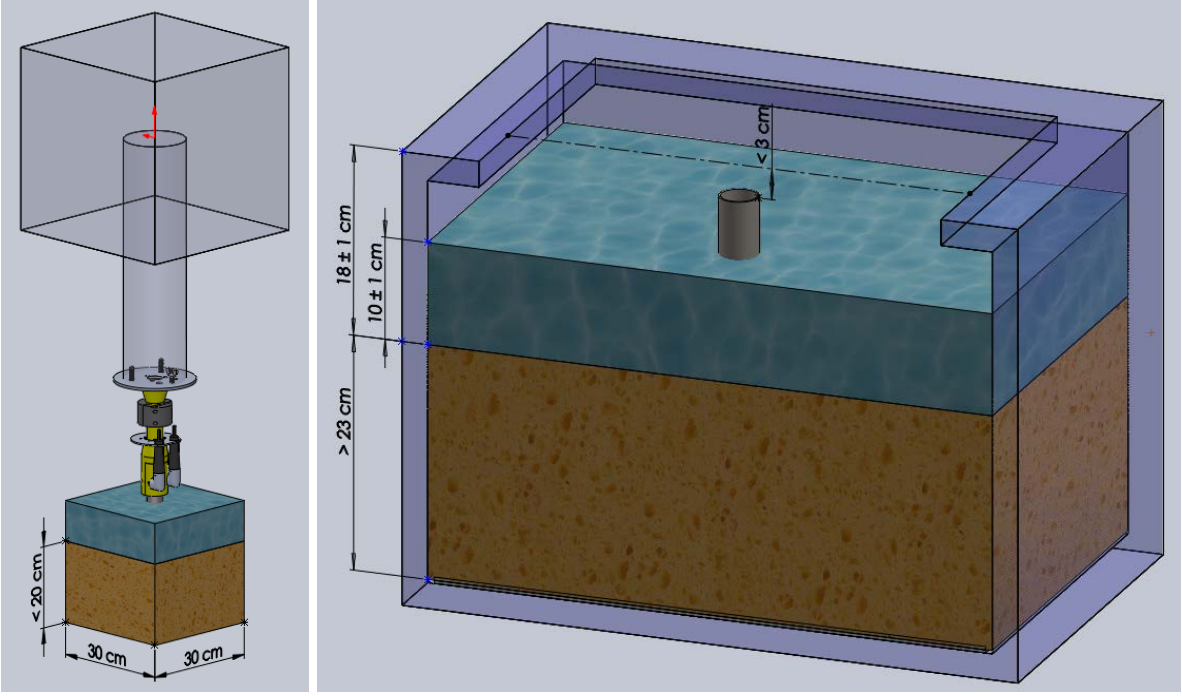


Figure A-4. Offshore simulation tank. ***Image created by Jason Roadman, NREL***



(a) (b)

Figure A-5. (a) Turbine, structure, and anchorage allowable volumes and (b) tank layout. ***Image created by Jason Roadman, NREL***

- The bottom of the tank will be filled with play sand (Lowe's item #293326 or equivalent). **Anchors shall penetrate the sand no more than 20 cm.**
- Water depth will be 10 cm ± 1 cm.
- For design considerations, students can assume the distance from the tunnel centerline to the top of the sand will be roughly 95 cm.
- The top of the team-designed foundation structure must include nominal 1.5-inch-outside-diameter tubing at the location where it attaches to the stub. This tubing (and any paint) must have an outer diameter of 1.500 ± 0.015 inches for the top 8 cm or more. Students can source this tubing in various wall thicknesses from McMaster (89955K389 through 8305T22) or an equivalent source.
- The maximum horizontal dimensions of the structure and anchorage shall not exceed a projected square area of 30 cm on each side, as shown in Figure A-5. **Note that this area is centered on the foundation structure top tube.** These dimensions will be verified during the safety and tech inspection portion of the competition by placing the assembled structure with anchor(s) in their deployed position entirely within a box of these dimensions. The box will be centered on the foundation tubing using a hole in its top.
- **There is now a no-excavation rule.** As a result, the teams are not permitted to move the sand aside during installation and then back-fill nor are they allowed to shovel or otherwise lift the sand up and put it back down with tools. The foundation system must engage the sand from the sand surface. The foundation structure is allowed to penetrate the sand, subject to the dimensions shown in Figure A-5 and tools can be used to drive that engagement. However, the design must be consistent with engaging the sand rather than with excavation. **A foundation that violates this rule will not be permitted to be used in a scoring run.**

Teams are encouraged to reach out to the reviewers early in the design process with any questions about their specific design and its compliance.

- The entire structure must be made of a ferrous metal (e.g., iron, steel, or stainless steel). No part of the structure may be made of aluminum, titanium, other metals, or any type of polymer or composite. Thin coatings are excluded from this rule (e.g., the structure may be painted or plated), but thick coatings (e.g., rubberized) are not allowed.
- The competition organizers will provide a "stub" or "transition piece" that will connect the top of the foundation structure to the place in the wind tunnel where the mounting plate was located in previous years. Figure A-4, Figure A-5, and Figure A-6 show depictions of the stub and interface method for the student turbines. The bolt pattern of Figure A-9 matches the small tunnels and previous competitions. The stub weighs 4.6 pounds.

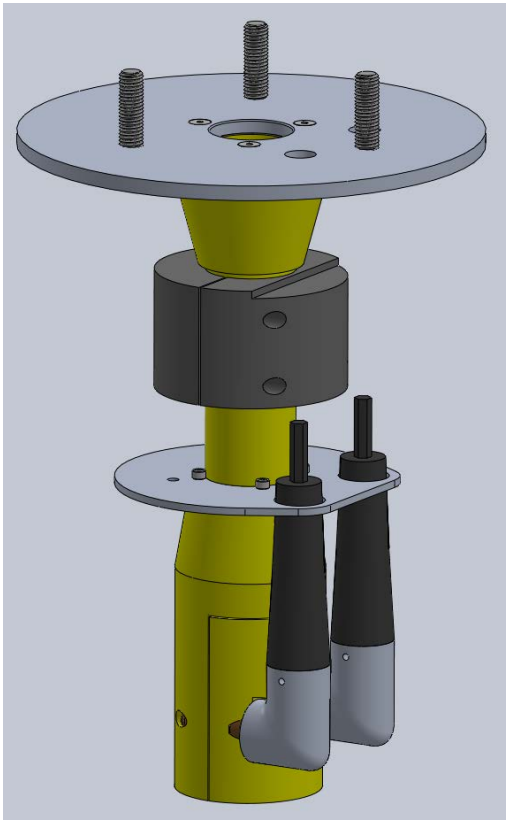


Figure A-6. Organizer-provided transition piece (stub) between the student tubing and turbine. ***Image created by Jason Roadman, NREL***

- Students should install their foundation structure and anchorage such that the top of the standardized tubing is flush with the top of the tank. It cannot stick out above the top and must be within 3 cm of the top (see Figure A-5[b]). Note that the tolerance between the top of the tank and the top of the sand will make the actual tolerance of the foundation height quite small. Teams are encouraged to consider ways for their foundation to adapt to meet the 3-cm specification.
- Students must assemble their foundation structure and anchorage such that the tubing at the top falls horizontally within a specified 10-cm circle within the tank (see Figure A-4).
- During the period immediately before a team's testing slot, the students will be given at least 25 minutes to install their foundation structure in the water tank at a location adjacent to the

tunnel. This task will be supervised by the organizers. The students will at no time be allowed to touch the water surface with any part of their bodies during installation. Only tools will be allowed to enter the water and no AC power will be provided for this task. This approach is to simulate installation of the device similarly to the way full-scale structures of this type are installed at sea. At the end of the testing period, students will be given 5 minutes to remove their foundation structure from the tank and may touch the water during removal only.

- To ensure that the wind turbine is plumb during installation and prevent leaning at the start of testing, students will be provided with a magnetic bubble level, similar to the one shown in Figure A-7.

Figure A-7. A bubble level (similar to the one shown here) will be provided to help align the foundation during installation. ***Image from Amazon.com***

- The installation of the electrical cable between the turbine and the electrical components outside the tunnel (e.g., point of common coupling [PCC], load) must be made through the top tube of the foundation structure. To facilitate this connection without placing connectors in the water, the student-provided cables from the outside electrical components to the turbine base must be installed through the foundation structure top tube during structure installation into the water/sand tank. At least 1 meter (m) of extra cable must be available above the top of the foundation structure top tube to facilitate installation of this cable through the stub and to the connectors in the turbine tower base during turbine installation (see Figure A-8). The connectors at the turbine base must be able to support the weight of the cable that passes down through the stub and into the water. Those connectors must always be kept dry, including during installation.

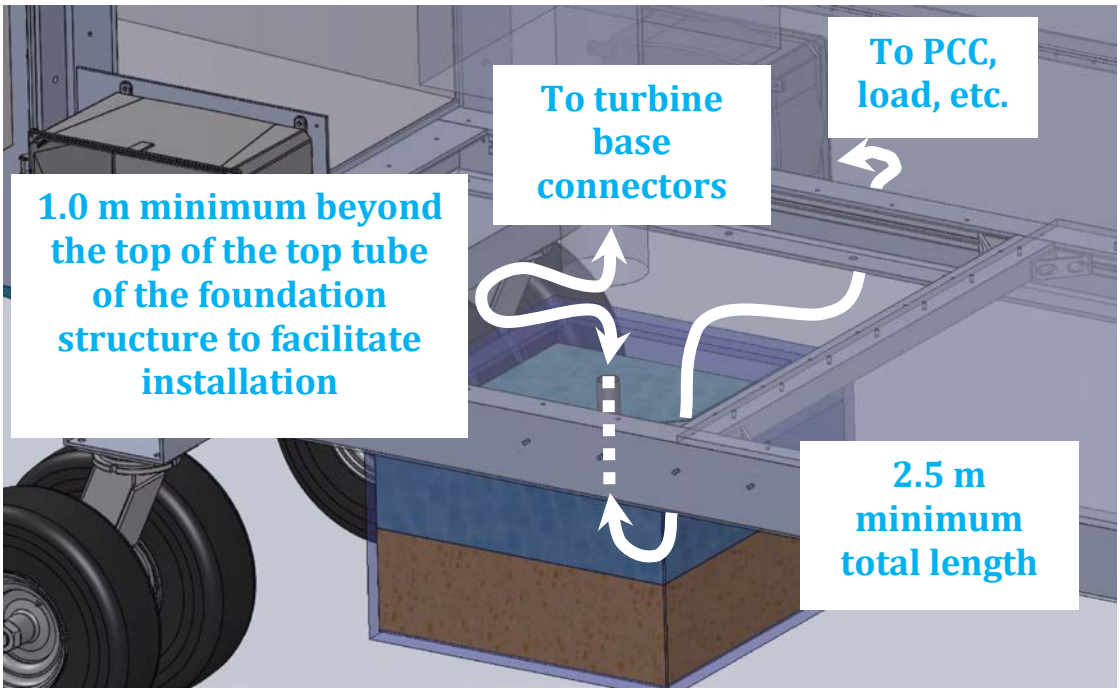


Figure A-8. The electrical cable from the wind turbine base through the foundation to the point of common coupling and load. ***Image created by Jason Roadman, NREL***

- A portion of the points awarded in this competition will be based on how much a team's structure weighs, with lighter structures yielding more points. The structure and all the elements to be installed inside the tank will be weighed dry by the organizers. The scores will not be absolute but rather based on a ranking relative to the other teams (see Section 3.3.3.6).
- The stub's horizontal displacement between the beginning and end of testing will be measured at a location just below the tunnel floor for scoring purposes. **This displacement should not exceed 25 mm.**
- If the structure experiences excessive movement, sliding, twisting, tilting, or sinking in the sand during testing, the tunnel will be immediately stopped, and no further points will be awarded.
- Three tunnels will be available in this year's competition: two small tunnels and the larger competition tunnel. The smaller tunnels will have the existing base plates as in previous years (see Figure A-9). The student-provided foundation structure will not be used in the smaller practice tunnels. It is for this reason that a consistent mounting pattern is used between all three tunnels for the turbine baseplate.
- No yaw turntable will be incorporated into this competition; however, students are still required to incorporate yaw capabilities into their turbine to align it with the predominant wind direction after installation.
- The turbine base plate must be constructed of material no thicker than 16.1 mm. It should be designed and constructed with adequate tolerances to smoothly fit over three studs, where it will be secured to the tunnel base flange/mounting stub with wingnuts. Figure A-9 shows the bolt pattern and sizing of this flange and the dimension for the hole in this base flange to allow cables and connectors to pass through.

- Teams may apply their engineering judgment to their own base plate design, keeping in mind that the turbine base must be designed to withstand the tension of the mounting studs. Torque values could be up to 50 newton-meters.

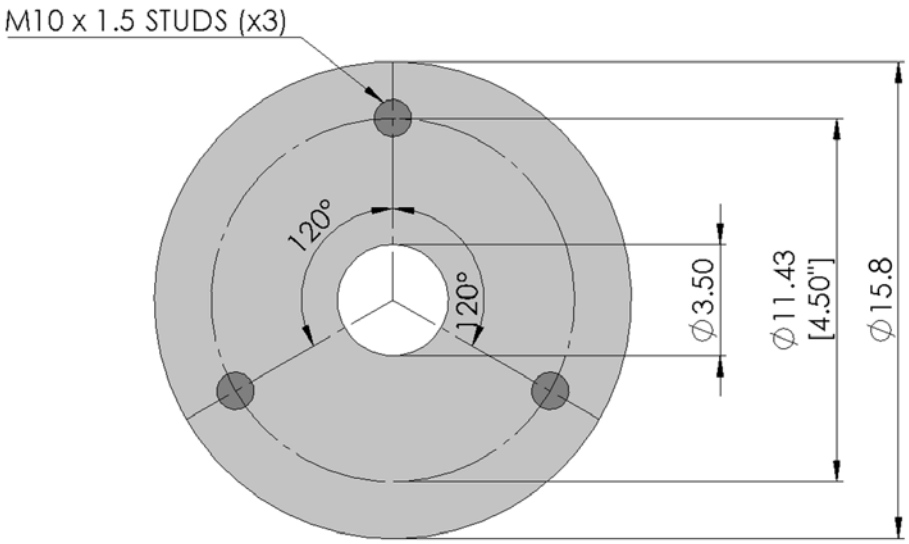


Figure A-9. Base flange dimensions for wind turbine attachment to the tunnel (dimensions in centimeters). ***Image created by Jason Roadman, NREL***

Physical Design Constraints Outside the Tunnel

Within practical limits, there is no size restriction for components located outside the tunnel. These components must be incorporated into closed enclosures that are firesafe and meet or exceed a National Electrical Manufacturers Association Type 1 rating. All components must be electrically insulated from the enclosures. Teams should also pay careful attention to the standards for ventilating these enclosures, which include:

- National Electrical Manufacturers Association Type 1 characteristics. Enclosures are constructed for indoor use to provide a degree of protection for personnel against access to hazardous parts as well as a degree of protection for the equipment inside the enclosure against ingress of solid foreign objects (should not be able to insert fingers or tools through the enclosure when closed). It is important that the intent of the National Electrical Manufacturers Association Type 1 rating be preserved once all connectors and/or passthrough devices are installed.
- All cable passthroughs in enclosures must use cable glands or other similar devices that provide both strain and chafe protection.
- Tape is not considered adequate sealing of penetrations or passthroughs in the enclosure.
- All electrical cables leading from the turbine to the electronic components located outside the tunnel must be in cable form (no individual strands except ground, if desired) and include connectors that are quickly connectable. No more than three cables are permitted including ground. Ground may be an individual strand if not included in the other two cables. Excessive cables, individual strands, or bare wires will result in disqualification from testing until remedied. Twisting two or more strands together is permissible if the resulting multistrand cable has a connector on the end. Multistrand cables are encouraged when used

in a logical way. For example, there could be one cable for all power wires and one for all control wires.

- Cables must be continuous and unbroken in the vicinity of the tank. No connectors may be in any position that would allow them to be submersed (Figure A-8).
- Neither screw terminals nor spade- or fork-type lugs are considered acceptable connectors outside of enclosures. Each cable connection from the wind turbine to the enclosure should employ a quick-attach connector. Ideally, teams should be able to connect all their cables in a few seconds.
- All electrical components must be mechanically secured to the enclosure.

Electrical Requirements

Figure A-10 illustrates the electrical configuration of the prototype turbine, competition data acquisition system, and PCC, which is the point of electrical measurement for the competition.

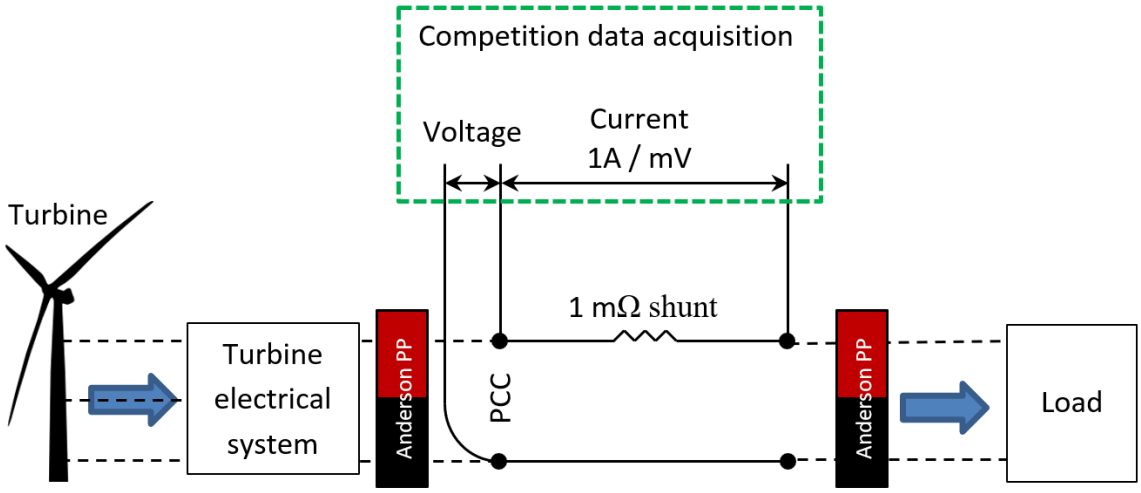


Figure A-10. Load, turbine, and point of common coupling arrangement. ***Image created by Lee Jay Fingersh, NREL***

Electrical requirements are as follows:

- Voltage must be DC at the PCC and is required to be at or below 48 volts at all times.
- The turbine base plate must be made from conductive material and tied to earth ground. To prevent overvoltage of the tunnel data acquisition system, turbine electrical system ground(s) must be electrically tied to this base plate with a 100-kiloohm or lower resistance connection.
- Teams are expected to choose their own generator and design their own wind turbine and load system. Off-the-shelf components may be used, but the turbine and load system should be designed and built by the teams. All components must meet safety requirements including, but not limited to, proper wiring practices, shielding of hazardous components, and proper heat rejection.
- The turbine electronics must be in separate enclosure(s) from the load to clearly differentiate load and control during inspection by reviewers, as shown in Figure A-10. The wind turbine nacelle may also contain turbine electronics, if desired.

Specifications for the Turbine Side of the PCC

Specifications for the turbine side of the PCC are as follows:

- Energy storage elements, such as capacitors and/or inductors, may be used in both the turbine and load, but not for bulk energy storage on the turbine side of the PCC.
- No batteries of any type, capacitors, or combinations of capacitors with nameplate voltage and capacitance ratings corresponding to over 10 joules of energy storage ($E = ½CV^2$) will be permitted.
- Turbine components may draw from the load but must register a zero state of charge at the beginning of the test.
- Wired connections between the turbine and load external to the PCC are allowed but must be optically isolated. The amount of power transferred through this connection must only be enough to facilitate communication, and that power may only be used for that purpose, not to power any other turbine systems. No appreciable energy may be transferred to the turbine around the PCC, even if that energy is not in the form of electrical energy.

Specifications for the Load Side of the PCC

Specifications for the load side of the PCC are as follows:

- Bulk energy storage is allowed in the load, provided it is used in a safe and reliable manner.
- To run the load, 120-volt alternating current will be provided, if desired.

Interfacing With the Competition Data Acquisition System

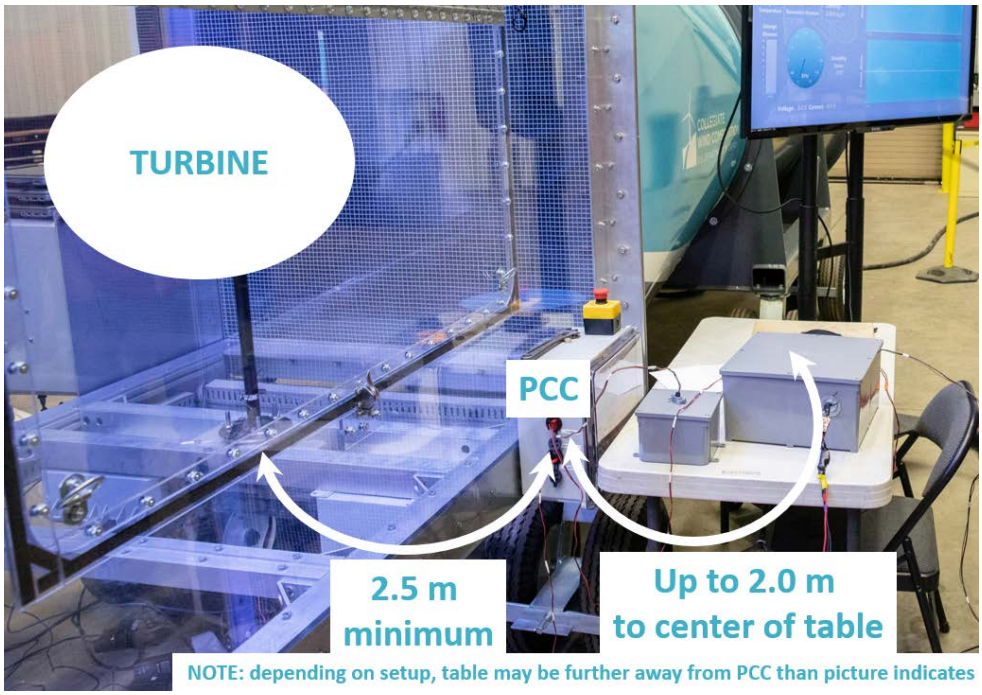


Figure A-11. Wiring layout of the point of common coupling and student load display table. ***Image created by Jason Roadman, NREL***

Protocols for interfacing with the competition data acquisition system are as follows:

- Wires should exit the tunnel at the wind turbine base through the center of the stub. As shown in Figure A-11, a table will be provided to display the load on the side of the tunnel and hold any turbine electronics enclosures external to the tunnel. Rough distances are shown in the figure, but teams should provide adequate lengths of wire to run from the PCC to accommodate their desired enclosure arrangement on the table.
- To interface with the PCC, wires should be terminated with Anderson Powerpole, PP15-45 or a compatible connector (a red and a black for positive and negative, respectively). See Figure A-12 for correct polarity. Incorrect polarity must be corrected before testing and wire color must match the connector housing color. Colored electrical tape on each end of the wire will be considered sufficient color matching.
- Teams are expected to provide their own Powerpole connectors of an appropriate size—15 amperes (A), 30 A, or 45 A—that are specified to handle wire gauges from 10–20 American wire gauge. Each team can choose the wire size it wants to use in this range as long as the appropriate current-carrying capacities are considered. All three pin sizes fit into the same housing (PP15-45), as stated previously. Note that locking clips are available to lock Powerpole connectors to each other so that they do not come apart and the organizers recommend the teams use them where applicable in their turbine designs or tower base connections. These clips are not usable at the PCC connection.

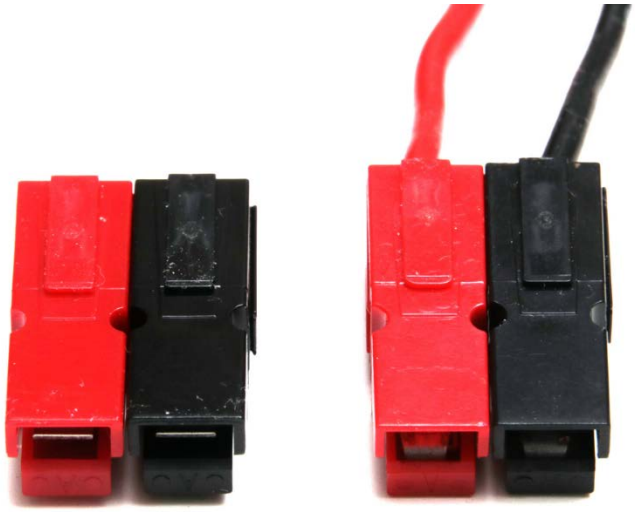


Figure A-12. Proper Powerpole polarity to match tunnel wiring. ***Image created by Lee Jay Fingersh, NREL***

- Wind turbines must be capable of shutting down on command through an emergency-stop button, as well as when electrically disconnected from the load. Specifically:
    - The emergency-stop button will be located outside the tunnel. It operates in the same manner as an industrial emergency stop chain. That is, it is closed during normal turbine operation and opened during an emergency stop when the button is pressed.
        - In industry, emergency-stop systems use this switch logic so that multiple switches in and around a piece of hardware, such as a wind turbine, can be wired in series in a single wiring loop. In this configuration, opening any switch

or a fault in the wiring will cause the whole circuit to open. Thus, an entire emergency-stop system can be monitored by a single channel input. If the switches used the opposite logic, the system would have to monitor each switch individually.

- The emergency-stop connector and wiring is rated for 3 A, thus it is intended to carry a low-current control signal—not high-current power. Teams must describe their emergency-stop system during the safety and tech inspection and explain how this design uses a signal that can never carry more than the rated 3 A.
- Each team must provide a cable containing two wires (no smaller than 28 American wire gauge) that reaches the PCC, as labeled in Figure A-12 . This cable must be terminated, prior to the competition, with a standard JST RCY female receptacle housing connector (Manuf. P/N: SYR-02T housing using SYM-001T-P0.6(N) for the corresponding male pin contacts) (Figure A-13).

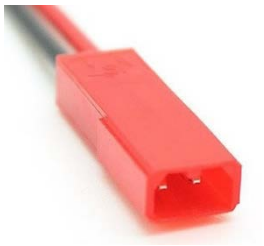


Figure A-13. Team-provided connection to the manual shutdown interface. ***Image created by Lee Jay Fingersh, NREL***

- The competition switch will be terminated with the corresponding polarity JST RCY male plug (Manuf. P/N: SYP-02T-1 plug housing using SYF-001T-P0.6[LF][SN] socket contacts) (Figure A-14).

Figure A-14. Competition-provided connector for manual shutdown interface. ***Image created by Lee Jay Fingersh, NREL***

Figure A-15. Laser tachometer used to measure turbine revolutions per minute. ***Photo by Werner Slocum, NREL***

- The competition data acquisition system uses a laser tachometer to measure wind turbine revolutions per minute (rpm) (Figure A-15). This system works by placing a piece of retro-reflective tape on a spinning portion of the turbine and pointing the tachometer's laser at this tape during operation. The tachometer measures the frequency of the tape's passing and converts this to an rpm. This measurement is critical for scoring the tasks related to turbine rpm. As such, **turbines must have an area of shallow curvature at least 4 mm wide and 20 mm in spanwise length** to place a piece of reflective tape in a location that is clearly visible by at least one of the two laser tachometers shown in Figure A-16. **This area must also be restricted to move as little as possible other than in the rotational direction** (i.e., it does not move axially along the horizontal axis when the turbine changes pitch angle).
    - Typical locations for reflective tape include spinners or blade roots. For vertical-axis wind turbines, tape is often placed on a blade at midspan. Wind turbines with active pitch should provide a location for the tape that does not pitch out of view of the laser. The tachometer is on a movable mount and pointing can be varied during the test if the motion is small, slow, or otherwise easily tracked but large or quick deviations can be hard to track.
    - **Failure to provide a location sufficient to measure rpm could result in a zero score for the tasks requiring rpm measurement, as the reviewers have no way to verify turbine rotational speed.** Students who are concerned about their specific application are encouraged to reach out to the Prize Administrators in advance for guidance.

Figure A-16. Laser tachometer sensors (circled in white) used to measure wind turbine rpm. ***Photo by Werner Slocum, NREL***

Note: only one tachometer is used at a time.

Safety Specifications

Competition staff will perform a safety inspection of the wind turbine and load system, which must be passed before they can be installed in the wind tunnel. Appendix E contains a draft version of the safety and inspection sheet used to evaluate the turbines. The turbine safety officials make the final and official determination about whether a turbine may be tested in the wind tunnel.

Reuse of Existing Equipment

New for this year, teams will not be allowed to re-use components or subcomponents produced during past competition cycles. Excluded from this rule are minor, purchased subcomponents such as screws and nuts, wires and cables, connectors, batteries, and electrical components such as resistors, capacitors, and inductors. This rule only applies to the hardware used inside and at the wind tunnel during testing. During development and testing, teams can re-use equipment such as meters, tools, dynamometers, wind tunnels, and so forth. If the teams have a question about re-using a particular subcomponent, they are encouraged to contact the Prize Administrators.

The teams will be required to certify, during tech inspection, that no components were reused. Any reused components cannot be used in or at the competition wind tunnels. If identical components are re-built matching those of previous years, teams will be required to declare those components, and explain why they were rebuilt and how they work.

Turbine Testing Specifications

Testing provides teams with the opportunity to demonstrate their wind turbine's performance through objective tasks, and the testing outcomes help determine if they have succeeded in developing a durable, safe, high-performing machine (performance is a strong indicator of a turbine's ability to compete successfully in the marketplace).

Exceeding the voltage limit set in Section Appendix A:Electrical Requirements will result in an immediate abort of the testing sequence, with all points gathered to that point retained but no more points earned after the abort. Teams may then attempt to fix the cause of the overvoltage and use their retest, if available.[10,11]

Verification of zero energy at the start of the test will be accomplished using the competition data acquisition system to measure zero current flow into the load at the PCC. Any questionable elements are subject to additional verification of zero energy by the testing team with a multimeter or similar device before the testing begins.

Only one team's wind turbine will be tested at a time. Teams are limited to 10 members (students and faculty advisors) within the testing area. Other members can act as spectators. Each team will have 25 minutes of tunnel time to install their turbine, commission it, test it, and uninstall. Note that this does not include the separate time provided to each school to construct their foundation structure in the tank before testing, which is discussed in Appendix A: Physical Design Constraints Within the Tunnel.

New for this year, the installation and commissioning process will be timed. Once the foundation has been positioned under the tunnel by competition personnel, the team will have 6 minutes to install and commission their turbine, and become ready for testing. Nominally, this can be considered as a 3-minute install process plus 3 minutes for turbine commissioning but there is no enforced division between these tasks. During the installation time, teams must thread their cables through the stub; connect all necessary connectors at the stub; connect all necessary connectors to the PCC, safety system, and external enclosures; place the turbine on the stub; fasten the three wing nuts by hand to the studs; close the tunnel door; and declare that they are ready for commissioning or testing.

During the commissioning period, the teams may ask for any wind speed from 5–11 m/s and do any work on their turbine or electronics they deem necessary to get their systems up and running. Teams may use as much of their 6-minute install and commissioning time limit as they desire, keeping in mind that exceeding the limit will result in the run automatically becoming a nonscoring practice run. A clock will be provided so that teams can keep track of their progress against the 6-minute time limit. Teams are strongly encouraged to practice assembly and preparation for testing so that they can beat the 3-minute nominal install time easily and without rushing, because rushing can lead to mistakes, damage, or injury. Furthermore, a quick install means more of the 6-minute time limit can be used for turbine commissioning, if desired. Students are encouraged to minimize install and commissioning time as much as possible because the complete series of

[10] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9880&p_table=STANDARDS
[11] https://www.mouser.com/pdfdocs/Why-are-Power-Designs-Moving-to-48V.pdf

testing tasks are expected to require upward of 15 minutes to complete, depending on how fast the turbine stabilizes during testing conditions.

Additionally, teams may signal at any time during the test that they would like to turn the session into a practice session but teams must remain cognizant of the time limitations. In this case, the score for this attempt will be zeroed, and the team can use their remaining time to troubleshoot and learn about their turbine's performance in preparation for an additional session, if they have one available.

If there are unforeseen delays caused by the organizers (e.g., a wind tunnel issue or power outage), the time spent rectifying the problem will not be included as part of the team's allowable minutes. Team members will only be allowed to touch their turbine electronics or controls during the following phases of testing: commissioning and manually restarting their turbine if they fail to restart after a safety shutdown task. Turbine failure is defined as anything out of the ordinary, such as excessive displacement, cracking, breaking, pieces falling off, smoking, sparking, or failure to produce an electrical current, and will be cause for immediate stoppage of testing.

If a team wants to re-test their wind turbine for any reason, they may request a single retest during the provided makeup sessions later in the competition. The retest will be a full test, and all scores from the first test will be replaced, regardless of the turbine's performance in the retest. Teams must confirm their desire to re-test with the organizers by 5:00 p.m. on the first day of testing. If the organizers do not hear from a team by this time, no retest will occur.

Students are encouraged to bring spare components and/or assemblies and design their turbines so that damaged parts or assemblies can be easily replaced. However, it is important to keep in mind that the turbine configuration throughout the entire competition should remain substantially the same as what is documented in the written report. For example, the number of blades, rotor axis, configuration, and operating voltage must remain the same. Teams with questions about any changes or altered turbine components or assemblies are encouraged to raise questions to the Prize Administrators well ahead of the competition to ensure they are adhering to this requirement.

Appendix B. Project Development Contest Specifics

According to a recent Great Lakes study written by the National Renewable Energy Laboratory,[12] offshore wind energy in the Great Lakes could become cost competitive in the long term based on national and global market drivers to decarbonize all energy sectors. For the 2024 Collegiate Wind Competition Project Development Contest, the organizers would like the teams to look at offshore wind development in Lake Superior or Lake Michigan. As of the writing of this rules document, the states had not initiated any leasing in these two Great Lakes, but most of the viable resource was found in deep water, requiring teams become exposed to floating offshore wind.

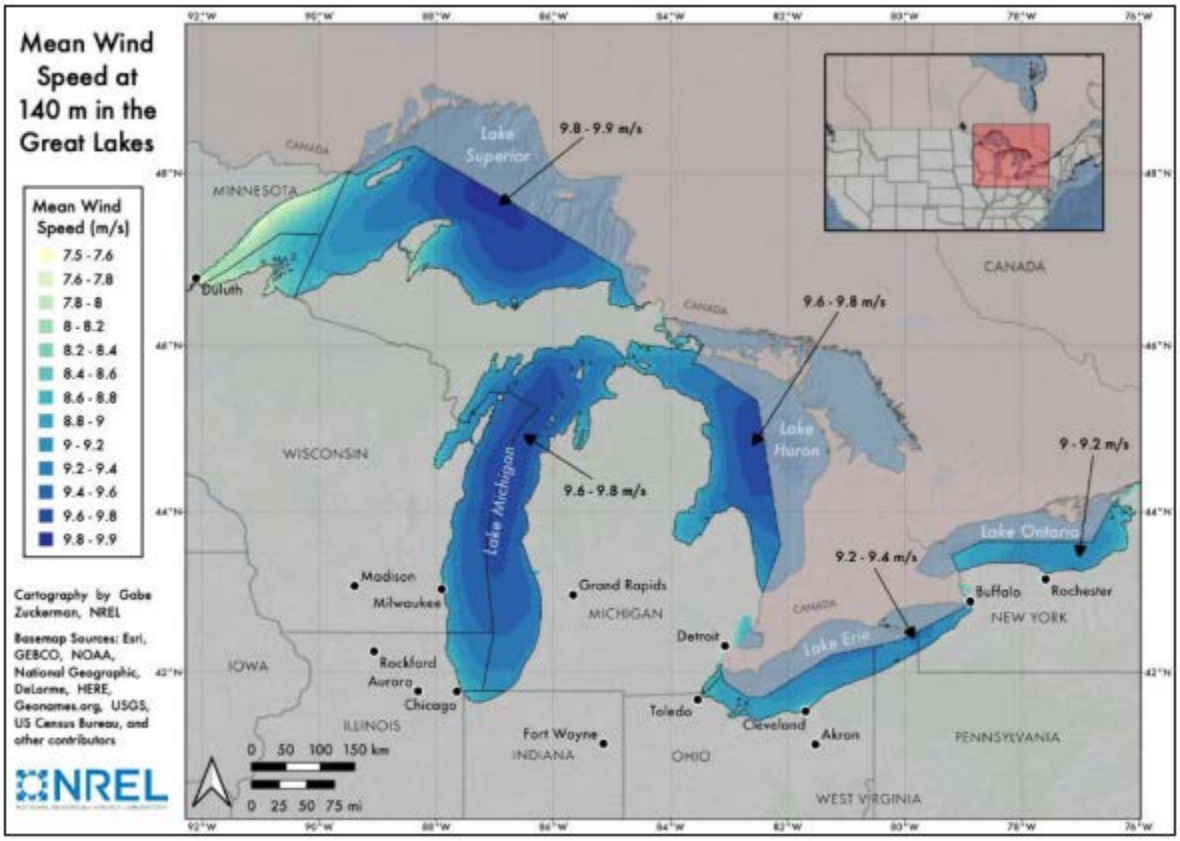


Figure B-1. Mean wind speed of the Great Lakes at 140 meters (m) above ground level.[12] ***Image from Musial et al. 2023***

The report by Musial et al. (2023) identifies important considerations for teams to consider as they investigate offshore wind farm development in the Great Lakes. This includes:

- Physical site characterization including, but not limited to, assessing freshwater icing challenges, soft lakebed sediments and shallow bedrock, and heavy metals in sediment.
- Infrastructure, ports, and vessel challenges including, but not limited to, assessing issues around access and estimating additional needs based on wind technology type.
- Technology options including, but not limited to, assessing infrastructure and supply chain needs to manufacture, transport, install, and maintain equipment.

[12] https://www.nrel.gov/docs/fy23osti/84605.pdf.

- Electric grid interconnection and integration including, but not limited to, identifying points of interconnection to the existing electric power network and assessing their power-handling capacities.
- Environment and wildlife including, but not limited to, assessing impacts to migratory species, fish ecology, aquatic resources, and more.
- Human use including, but not limited to, assessing coexistence with residents and tribes in the United States and Canada that live in the region.

Also, new this year, students are encouraged to incorporate offshore wind energy generation as part of a hybrid power plant, which includes consideration of development and operation for ancillary grid benefits, alternative forms of market participation and offtake agreements, and multitechnology solutions. Hybrid power plants, which combine multiple generation, storage, and end-use technologies, are becoming increasingly popular as developers seek innovative and sustainable solutions to integrate with the grid, participate in multiple and emerging markets, and maximize policy incentives.

Offshore-wind-based hybrid power plants are already being developed globally. Equinor recently deployed 1.3 MWh of battery capacity to support the Hywind Project,[13] Ørsted has announced their intent to support Hornsea 3 offshore wind farm with battery storage,[14] and RWE recently won the HKW VII offshore wind lease with plans to incorporate both batteries and floating solar.[15] Hydrogen is also being considered as a viable technology combination with offshore wind energy. Shell is currently developing 200 MW of electrolyzer capacity to be powered by the Hollandse Kust (Noord) offshore wind farm,[16] the Dutch government announced a tender for 500 MW of offshore-wind-produced hydrogen earlier this year,[17] and Germany has similarly set aside acreage in the North Sea for offshore-wind-produced hydrogen.[18] In the United States, offshore wind energy developers are considering similar options for battery storage and hydrogen production.

[13] https://www.equinor.com/news/archive/26june2018-equinor-has-installed-batwind
[14] https://www.powermag.com/orsted-plans-battery-storage-to-support-hornsea-3-offshore-wind-farm/
[15] https://dredgewire.com/netherlands-awards-lease-for-integrating-offshore-wind-and-solar-power/
[16] https://www.shell.com/media/news-and-media-releases/2022/shell-to-start-building-europes-largest-renewable-hydrogen-plant.html
[17] https://www.hydrogeninsight.com/production/tender-for-500mw-offshore-green-hydrogen-project-in-north-sea-announced-by-dutch-government/2-1-1422681
[18] https://www.hydrogeninsight.com/policy/offshore-hydrogen-germany-plans-1gw-of-wind-powered-green-h2-production-at-sea-with-pipeline-to-shore/2-1-1392107

Appendix C. Connection Creation Contest Specifics

The Connection Creation Contest is designed to forge stronger connections between competition participants, the wind energy industry, students, and the team's local community.

This contest requires developing an overarching outreach strategy (outlined in Section 3.5.1) that includes three proposed activities from amongst the available options listed in the next section.

In alignment with expectations in a professional setting, the team will be required to present and summarize the purpose and impact of their work. This contest is designed, in part, to develop this skill set. Specific requirements are defined in the following contest segments, and deadlines are included in Section 2.1.

Sharing the team's progress will also help employers understand the skills the team has developed through involvement with the Collegiate Wind Competition (CWC) and prepare members for the final event presentation.

Teams are encouraged to capture high-quality photos and videos of their activities to present during the final presentation and to include in their reports (described in Appendix D).

Teams should provide adequate photo release forms to any event attendees they take photos or videos of, especially at events where minors are present. (Recommend checking with the lead academic institution's communication office for forms.) for any event attendees they take photos or videos of, especially at events where minors are present.

Events must occur prior to the final competition date so teams can speak to these experiences during their presentation to the reviewers. An explanation of the goals of the event, the planning process, estimated number of attendees, and an impact assessment should be included in the final presentation. One exception is if the team chooses to propose an activity to perform within the Renewable Energy Educational Pavilion at CLEANPOWER.

Contest Elements

Teams need to select three activities from the following subtopics. Teams should not plan to execute more than three activities to ensure appropriate focus and impact across distinct activities that have been identified in their overarching outreach strategy.

Understanding the Wind Energy Industry

For this contest element, teams are asked to explore multiple sectors of the wind energy industry and learn about career opportunities. The goal of this activity is to learn more about the industry and create outreach materials to educate and inspire younger students. If the team opts to perform this activity, they must interview at least four industry professionals to learn about their role and produce four slides highlighting insights from the interviews. This activity should only be performed if the team can learn from the careers being explored. As part of the final report, the team must include what they learned from the interview and how it impacted their activities in the other competition contests. There will be no template for the interview slide, in order for the team to best convey how these interviews were integrated into their overarching performance in the competition. The professionals interviewed may be alumni that have gone into the wind or

clean energy industries or other industry contacts. Teams are responsible for making their own connections to professionals in the industry.

Returning teams may not interview any individuals they have already interviewed in past competition years. Any teams in need of support developing new contacts can begin their search using LinkedIn, webinars on wind energy topics, or biographies from clean energy conferences.

Teams should ask questions that will help them develop a clear and compelling presentation covering specific details about each job they are highlighting, what is interesting about it, and requirements needed. Details on other entry-level positions, internships, scholarships, or fellowships available within each organization are also of interest.

Please note that these industry professionals will be volunteering their time. Be mindful of their availability and ensure team members are fully prepared, professional, and concise with their interactions.

Teams should choose professionals in four different sectors of the industry. Examples include:

- Offshore, land-based, or distributed wind energy
- Project development, manufacturing, research and development, or operations
- Wind turbines or components (e.g., gearboxes, generators, blades)
- Stakeholder engagement, communications, or marketing.

The four interview slides developed in this contest element will be part of the final presentation along with the submissions from the other contest elements. More details on requirements for the final presentation are included in Section 3.5.2.2.

Student and Local Community Engagement

With the high-level goals outlined in the team's outreach strategy in mind, if this activity is selected, each team must organize and run one educational event with middle school, high school, or college students. These engagement events may be done virtually or in person. Events could include but are not limited to:

- Participation with an established STEM-focused organization/event, such as KidWind
- An event at a local school
- An event at the team's university that may include recruitment but must also incorporate outreach
- An event within the team's local community.

Teams are encouraged to describe their project and share highlights from their story. Teams should also share what they have learned about wind energy and include some discussion about career opportunities in the wind industry. Teams should draw from elements learned through their other Creation Connection Contest activities, including, if applicable, Understanding the Wind Industry interviews and/or other work on the competition to date.

Development of an Educational Webinar

If this activity is selected, the team will develop an educational webinar for all CWC teams. To sign up to host, organizers will provide the team with available dates. The webinars will be

recorded and included in the CWC reference library. The topic of the webinar should be of interest to the CWC community (e.g., wind energy, clean energy, entering the workforce, career opportunities), and may also support broader recruitment to CWC and similar workforce activities. Topics will need to be submitted via email by the due date for the midyear submission, and must be approved by CWC organizers.

The webinars may be held as live presentations or prerecorded videos and should include time for CWC students to discuss the topic and/or ask questions of the presenters or hosts.

Host an Industry, Alumni, or Interteam Activity

Teams who select this element will organize an activity that benefits the greater CWC community. This activity must include at least two other CWC teams, may be held virtually or in person, and may be live events or ongoing discussions on a virtual platform such as the CWC LinkedIn group. Teams may choose to include industry and/or alumni in these activities to foster connections with current CWC students.

Events could include (but are not limited to) hosting:

- A job or internship fair
- A training session related to career development (e.g., using LinkedIn, resume building, and so on)
- A networking event with CWC alumni from multiple teams
- An industry panel.

Execute a Cross-Technology Collaborative Opportunity

Teams who select this element will develop material(s), demonstration(s), activity(ies), or host an event that highlights the interconnectivity of certain clean energy options, with one of the options being wind energy. The material/demonstration/activity/talk should be designed to stimulate cross-technology discussion and raise awareness of important interdependencies as the nation strives to achieve its clean energy and decarbonization goals.

Propose Activity To Perform Within the Renewable Energy Educational Pavilion at CLEANPOWER

Teams who select this element will propose an activity that could be performed within the Renewable Energy Educational Pavilion at CLEANPOWER. Organizers will do their best to provide space/time for teams to perform their proposed activities at CLEANPOWER but cannot promise all teams who submit proposals will be able to execute their activities. Scoring will be independent of any execution of an activity. An opportunity to execute an activity is not an Indication of how that activity will be scored.

Activities could include, but are not limited to:

- Sharing an educational demonstration
- Hosting a panel
- Hosting a quiz bowl
- Hosting a fun challenge that can be open to industry.

Communications Materials

Teams who select this element will create at least one piece of marketing material aimed at either inspiring younger generations to join the wind energy workforce or addressing potential public misconceptions regarding wind energy.

Marketing materials could include:

- Promotional videos
- A social media campaign
- Fact sheets
- Websites and blogs
- Online or print ads.

Teams will be evaluated on the quality of the product, rationale for decisions, and the teams' ability to show proof of impact through metrics. Teams must be creative and identify the most effective communications techniques through their research.

Appendix D. Communications, Submissions, and Contest Details

It is each team's responsibility to stay abreast of the latest competition communications from the Prize Administrators. Communication between the teams and the Prize Administrators occurs via one or more of the following:

- HeroX Forum. Official communications suitable for viewing by all team members and Prize Administrators will be posted on this forum.
- HeroX Resources. All CWC resources, templates, and meeting recordings will be uploaded to the HeroX Resources page.
- Virtual Meetings. Teams are strongly encouraged to participate in scheduled virtual meetings with the Prize Administrators. Invitations and instructions for participation in these meetings are provided by the competition operations manager(s) via email and on the HeroX Forum.
- Email. The official email address for the competition is Collegiate.Wind@nrel.gov; questions should be sent directly to this email address, and answers that may be of interest to all teams will be posted on the competition's HeroX Forum. For expediency and to protect confidentiality, the Prize Administrators may choose to communicate via team members' email addresses, as listed in the HeroX database; however, official communications occur via the HeroX Forum.
- Website. The Collegiate Wind Competition website will showcase the various elements of the competition, ongoing team engagement, and information about how to participate in future competitions. The website will also feature important documents, such as this Official Rules document and submission templates.

Branding

Teams are expected to set up a professional space in their booth to highlight their branding. This setup can include the concept design, posters, team logo, and school information. The team booths provide the' opportunity to showcase all the work the teams have put into their project over the course of the year and are the best way to communicate their efforts to the industry.

Reviewing and Scoring

A panel of contest reviewers will be scoring team performance in each challenge and for each submission. The reviewers will come from diverse backgrounds and have expertise related to the content they are responsible for evaluating. This diversity helps the reviewers evaluate performance from a variety of angles.

Prize Administrators will ensure that, to the extent possible, reviewers will not:

- Have personal or financial interests in, or be an employee, officer, director, or agent of any entity that is a registered participant in the competition
- Have a familial or financial relationship with an individual who is a registered participant
- Discuss team performance with other teams or their advisors.

Reviewers for midyear submissions may be different than those providing reviews at the final event. The director of the U.S. Department of Energy Wind Energy Technologies Office is the judge of the competition and will make the final determination.

Team Feedback

In an effort to provide as much feedback as possible, teams will receive their scores following completion of the competition. Teams will also receive a short narrative derived from the challenge reviewers' deliberations after each team's presentation.

Submittals and Submission Locations

Go to HeroX and follow the instructions for registering and submitting all required materials before the deadline in Table 1 and as displayed on the HeroX website.

The HeroX platform provides a space where parties interested in collaboration can post information about themselves and learn about others who are also interested in competing. Teams can submit early copies and updated revisions until the deadline.

Scoring Penalties

Scoring penalties include the following:

- No points will be awarded for a submission that is late.
- Five percent will be deducted for each incorrectly named file.
- Substantive and incorrect report formatting will be penalized up to 30% at the discretion of the reviewers. Formatting requirements are in place (and included in this appendix) to ensure an equal amount of space for all teams to tell their stories to the reviewers. Therefore, teams must not use more than the allotted space allowed.
- Pages in excess of the page limit will not be reviewed or scored.

All submissions must be saved in the formats indicated.

Written Submission Formatting Requirements

The following format requirements apply to the midyear submissions and written reports:

- Reports must adhere to the page limits detailed in the respective sections. Cover pages and bibliographies do not count against the page limits, but any table of contents, executive summaries, and appendices do.
- Pages must be 8.5-by-11 inches, paginated, and have 1-inch margins at a minimum.
- References must begin on a new page with a distinct page number format from that used for the body of the report.
- Content must be single-spaced.
- The body of the report must use an 11-point font size at a minimum.
- Students may include images up to the number specified in the respective submission section.
- Images should contain no tables and little text, only that which is necessary to identify the image, such as a one-line figure caption. Extensive text in the figure section will be ignored and not count toward the team's score.
- Captions for figures and tables must be numbered for easy navigation.
- Submission-specific guidance for images, equations, and tables are as follows:
    - For the midyear submissions, images should be placed at the end of the document to make it easy for reviewers to determine page limit compliance and do not count

against the page limit. Equations and tables should be placed within the text and count against the page limit.
    - For the written report, images, tables, equations, and so on must be included within the text and count against the page limit for written reports.
    - For the metrics report, photos or social media images must be placed at the end of the document to make it easy for reviewers to determine page limit compliance and do not count against the page limit. Charts, tables, and so on used to show metrics must be placed within the text and count against the page limit.
- The final documents must be submitted as an Adobe PDF file, adhering to the following criteria:
    - Report sections must be bookmarked.
    - Fonts must be embedded.
    - All images must have a minimum resolution of 300 dots per inch.
    - **Do not** create a PDF from scans or by outputting the content into a raster image format (e.g., .jpg, .tiff, .png, or .gif) and then creating a PDF from the images.
    - **Avoid** all-raster PDFs. Although they are large files at 300 dots per inch, they are of unacceptable quality at lower resolutions and are not scalable without degradation.

Audiovisual Presentation Format Requirements

Audiovisual presentations are not required for all contests, but if used, they must adhere to format requirements. The final presentation must be delivered digitally to the team's Box folder in advance of their presentation during the competition. Teams should also bring the file on a USB drive to their presentation slot. Specific requirements include the following:

- Videos must be recorded in a 1,920-by-1,080 frame size with a frame rate of at least 30 frames per second.
- Videos must be recorded horizontally rather than vertically.
- Teams may use any video recording software and file format they prefer.
- If the video includes narration, please include a transcript.
- No background music that violates U.S. copyright laws is allowed; all incorporated music must be an original or royalty-free composition, and proof of licensing must be submitted with the final file and transcript.

Electronic File-Naming Instructions

The required file-naming convention for all electronic files is:

[TEAM ABBREVIATION]_[SUBMISSION DATE (YYYY-MM-DD)]_[CONTEST ABBREVIATION]_[SUBMISSION ABBREVIATION].[EXTENSION]

A list of teams and abbreviation names will be shared on the HeroX platform prior to the midyear submittals. Table F-1 lists submission names and abbreviations.

Example: A design report submitted by California Maritime Academy as part of their final deliverable, would have the following file name: CALMARITIME_2024-04-18_TD_Design Report.PDF.

Table D-1. Submission Names, Contests, and Abbreviations

Submission Name	Contest Abbreviation	Submission Abbreviation
Design progress and prototyping to date	TD	Design Progress
Prototype fabrication and testing video	TT	Prototype
Preliminary Project Development report	PD	Preliminary Report
Outreach strategy and team story report	CC	Midyear Report
Turbine design report	TD	Design Report
Timed assembly video	TT	Timed Assembly
Technical inspection prior to competition	TT	Tech Inspection
Project Development report	PD	Final Report
Metrics report	CC	Metrics Report
Competition poster		Poster
Project Development Presentation	PD	Final Pres
Connection Creation Contest presentation	CC	Final Pres

Appendix E. Sample Safety and Technical Inspection

A sample of the sheet used to evaluate test wind turbines prior to competition is provided in Table E-1. Teams are required to work through this process in advance of the competition with a qualified technician, advisor, or similar personnel as part of the final midyear project submission. **If a team makes a change to their system after passing tech inspection that could affect anything evaluated during that inspection, they must notify the Prize Administrators and undergo a revised inspection. Failure to do so may lead to disqualification.**

Table E-1. Sample Inspection Sheet for Evaluating Test Turbines

Collegiate Wind Competition 2024 Safety and Tech Inspection Sheet	
	Team Name: _____
SAFETY – Cannot practice or test if noncompliant	
O	Wiring is deemed safe and uses adequate gauges—no electrocution or overheating hazard
O	Droop cable is continuous and unbroken between turbine and point of common coupling (PCC); connectors capable of being kept dry during install
O	Electrical systems are tied to earth ground with 100 kiloohms or lower resistor
O	Energized electrical components are adequately shielded—both electrically and mechanically (National Electrical Manufacturers Association Type 1 is preserved)
O	For the team load: all charging or bulk energy storage follows industry-accepted best practices (i.e., safe circuitry overvoltage/undervoltage protection, flame/spill containment)
O	Proper heat rejection
O	Voltage is ≤ 48 volts (V) direct current at PCC at all times
O	Team load runs on 120 V alternating current maximum
O	Turbine mounting flange fits over studs without having to be forced (test fit to tunnel flange)
O	Top of foundation has tubing 1.500 ± 0.015 inches at least 8 centimeters (cm) long (test fit competition-provided stub)
NON-SAFETY – Can practice but must fix prior to official testing	
General	
O	No components are re-used from previous years. Rebuilt components are declared and explained
O	Remind teams about timed install—6 minutes for install and commissioning
O	All external wiring is in cable form and utilizes commercial connectors (no screw terminals or spade- or fork-type lugs). No single-pin connectors except ground. **Maximum three connections including ground.**
O	All electrical components outside the tunnel are contained in enclosures meeting National Electrical Manufacturers Association Type 1 or greater (no tape)
O	Cable passthroughs in enclosures provide strain and chafe protection (e.g., cable glands)
O	Turbine electronics and load electronics are in separate enclosures
O	All electrical components are mechanically secured to the enclosure
Wind Turbine	
O	Turbine for testing is substantively the same as in the Design report
O	Turbine side of PCC: no batteries or excessively large capacitors (individual or combination ≤ 10 Joules)
O	Turbine is capable of fitting through the door in one assembly

Structure and anchorage

- O Constructed exclusively of ferrous metal, thin plating and paint (no thick coatings e.g., rubber)
- O Capable of being assembled with only tools touching water
- O Measure dry weight of all foundation structure and anchorage components: _____ grams

Volume

Rotor and nonrotor components are:

- O Within a 45-cm cube centered horizontally on the flange axis, shifted at most 10 cm fore or aft
- O Vertically, the rotor midplane is 60 cm ± 3 cm above the flange top plane to center it in the test section

Nonrotor parts only:

- O Base plate is ≤ 16.1-millimeters thick and tower is less than a 15.8-cm-diameter cylinder from the base of the cube to the tunnel floor

Foundation and anchorage:

- O Fits within a projected area 30 cm on a side when assembled (test fit in competition-provided box)
- O Anchors penetrate sand no more than 20 cm (test fit in competition-provided box)
- O When assembled, mounting tube is at or below the lip of the tank by no more than 3 cm

Wiring

- O Wiring will reach PCC (test fit)
- O Emergency stop terminated with standard JST *female* receptacle with *male* pins (test fit to data acquisition system)
- O Emergency-stop signal (JST connector wiring) never draws more than 3 amperes and uses normally closed logic during turbine operation (students to describe)
- O Powerpole polarity is correct (test fit to PCC) and wire color matches connector color

Load

- O Team-supplied load

INSTALL

- O Reflective tape for revolutions per minute

Inspecting Reviewer Signature: _____

Date and time: _____

*Noncompliance checkboxes should be circled above

Reinspecting Reviewer – initial compliancy above with date and time of reinspection

Reinspecting Reviewer Signature when complete: _____

Date and time: _____

Reinspecting Reviewer – initial compliancy above with date and time of reinspection

Reinspecting Reviewer Signature when complete: _____

Date and time: _____

Appendix F. Roles and Responsibilities

Table F-1 shows the competition roles, who is performing in each role, and what the role entails.

Table F-1. Roles and Responsibilities

Role	Individual(s) Assigned	Definition
Collegiate Team	Multiple	Collegiate team members are led by the student lead and subteam leads under the mentorship of faculty advisors within the rules and requirements of the competition. Teams comprise undergraduate students only, but graduate students may be involved as mentors or advisors. There is no limit to team size. However, the number of students that teams may bring to the competition will be limited based on space requirements. Interdisciplinary teams are encouraged in the following areas of study: engineering, business, marketing, environmental science, communications, policy, and social sciences. Only undergraduate student team members may take an active role in any competition event.
Student Lead(s)	Minimum of one and maximum of three per team	The student lead should take on the primary leadership and organizing responsibilities for the team under simple mentorship from the faculty advisor. In addition, the student lead attends informational sessions, represents the team when communicating with competition organizers, and disseminates information received from the competition organizers over the course of the entire competition, including monitoring communications during the event. The collegiate team student lead is effectively the leader of their collegiate team in all aspects of the competition.
Faculty Advisor	Minimum of one per team starting in Phase 2	Serves as the lead faculty member of a participating school in the competition. This person provides mentorship to the team throughout the competition and provides a supportive environment for student team leads to thrive in. The faculty advisor teaches, advises, and coaches the students on the skills necessary to compete in the various aspects of the competition. Some teams may specify multiple faculty advisors who are contacts for the team, but in this case, one person should be identified as the lead. Faculty advisors can provide feedback about the team's design so the students can identify mistakes, prove technical rigor, or demonstrate feasibility of their concept. It is not appropriate for faculty advisors to be actively working on a wind turbine or making decisions.
Student Mentors	Multiple	Because of their unique perspective, students who have completed their undergraduate degree or

Role	Individual(s) Assigned	Definition
		graduate students are encouraged to act as mentors to the collegiate team. Similar to the faculty advisors, mentors should provide a supportive environment and the educational background necessary throughout the contest without making active decisions themselves.
Supporting Faculty	Multiple	Supports the faculty advisor in the previously mentioned duties but typically does not directly engage with U.S. Department of Energy (DOE)/National Renewable Energy Laboratory (NREL) Collegiate Wind Competition staff.
Competition Manager	DOE	Represents DOE and has the final decision-making authority in all aspects of the competition.
Prize Administrators	NREL	The prize administrators leads correspondence with the collegiate teams regarding contracts, challenge questions, and team expectations. During the competition, the prize administrators are the primary point of contact for questions related to engagement with the reviewers, logistics, and protocol. Tasks include developing team schedules, coordinating/collating scores and team feedback from the challenges in time for the awards ceremony, and supporting the collegiate teams and reviewers.
Contest Reviewers	To be announced prior to the competition	Conduct and evaluate each contest at the competition.
Competition Judge	Director, WETO	The director of WETO is the judge of the competition and will make all final determinations.

Appendix G. Learn-Along Schools

Teams that submitted under Phase 2 but are not selected for Phase 3 are encouraged to keep learning and are welcome to participate in some or all of the competition contests. Becoming a learn-along school is an opportunity available to Phase 1 winners that did not win Phase 2. Teams not selected in Phase 2 are not eligible for additional prize funding. If teams did not win Phase 2 and would like to continue as a learn along team, they should send an email to collegiate.wind@nrel.gov indicating which of the four contests (Turbine Design, Turbine Testing, Project Development, and Connection Creation) they are opting in to continue with by Thursday, April 4, 2024, at 11:59 p.m. Mountain Time so that the organizers can plan accordingly.

Teams that are new and building institutional knowledge are encouraged to participate in submissions but consider electing to be a learn-along school and build a simpler wind turbine. That turbine should focus on rotor design, power electronics, and basic reliability. The best-performing learn-along schools will be given a chance to test this simpler turbine in the small wind tunnels without the need for an offshore foundation.

This activity does not require that a team build a small wind turbine, though they are encouraged to do so and find alternative ways to test the wind turbine's performance. Students are encouraged to develop a testing protocol to validate their turbine on their own and use resources beyond wind tunnels. Competition organizers and reviewers are available in the forum to help brainstorm ideas and provide advice on how to get worthwhile results safely.

All Phase 1 teams are welcome to attend the final event for observation and networking, regardless of whether they opt in to become an official learn-along team.

Teams who opt into the Turbine Design, Project Development, and Connection Creation contests will receive valuable, real-time feedback during a feedback session for each contest they opt in to. The feedback sessions will include industry experts and occur at the end of the competition year and are based solely on final presentations for that contest. No additional submissions are expected beyond final presentations. No submissions after the Phase 2 selection will be scored or reviewed. Feedback sessions with industry experts will be held virtually approximately 2 weeks after the competition and will be facilitated by a National Renewable Energy Laboratory representative. The schedule for presentations will be shared with learn-along teams in addition to the communications for all competing teams.

Teams who opt into the Turbine Testing Contest must submit the tech inspection prior to competition and timed assembly milestones during the spring semester. These teams must also opt into the Turbine Design Contest. Due to scheduling and tunnel availability, only the learn-along schools with the highest scores on those testing submissions will be offered a chance to test in the small wind tunnels at the final event.

Learn-along teams will receive:

- Access to all the resources provided to competing teams
- Feedback sessions with industry experts for each contest that the team elected to complete.

    - This feedback session will begin with a team presentation, as previously described. The presentation will be followed by a question-and-answer session so that students can learn from industry experts.
- A shared space among the competing teams' bullpens to work during the competition if the learn-along team has selected to participate in the Turbine Testing contest and has been selected to test in one of the National Renewable Energy Laboratory tunnels
- One easel to display a competition poster near the team's bullpen area, if attending and have participated in at least two of the contests
    - This display will provide learn-along teams the chance to demonstrate their work to industry during the networking hour.

All learn-along teams will have access to the general resources provided to competing collegiate teams to support contest activities, including:

- Rules and requirements
- All available Collegiate Wind Competition (CWC) resources (e.g., educational webinars, papers, other educational resources)
- CWC forum access for students to get answers to questions
- Access to the CWC LinkedIn group for students to build connections with current CWC participants, CWC alumni, and wind energy professionals
- Student rate for conference attendance
- Invitation to all educational webinars.

Learn-along teams will not receive:

- Testing time in any of the National Renewable Energy Laboratory wind tunnels, unless specifically notified based on deliverable scores
- Space in the bullpens with the rest of the competing teams, if not testing a turbine.

For learn-along teams testing a wind turbine, the same timed assembly rule (as outlined in Appendix A: Turbine Testing Specifications) applies, but the consequence for failing to assemble in the allotted time is that the team will go to the end of the testing queue for learn-along teams.

It is important to note that primary interaction with competition staff will be through the 1-day feedback session and answering questions on the forum. Participation as a learn-along school is primarily an independent activity in which schools are encouraged to use the framework of the CWC rules to shape an educational program for academic growth. Additionally, participating teams will have a chance to provide feedback to organizers at the end of the year.

Appendix H. Logistics

Many logistical details will be provided throughout the course of the academic year, and leading up to the event. Although organizers will make concerted efforts to inform teams, teams are responsible for familiarizing themselves with the details provided to proceed accordingly.

Proactive risk management in the face of uncertainty remains fundamental for any line of employment. The same is true for this event. As a result of the COVID-19 pandemic, the rules are written in a way that ensures readers will clearly understand all aspects of the CWC in case the in-person event should become a virtual competition.

Should the venue change, an announcement will be made as soon as possible.

Teams are encouraged to communicate rules that are unclear, misguided, or in need of improvement. The organizers will seriously consider suggestions if they are feasible and intended to improve the competition, its rules, measurable outcomes, fairness, or precision.

Event Schedule

The event schedule will be provided to participating teams once it has been finalized. When organizers draft the schedule, slots will be assigned randomly. Teams may send requests for special consideration regarding scheduling; however, organizers are not obligated to accommodate them. Organizers will not accept requests for schedule adjustments after the lottery has been completed. Assigned slots will include:

- A check in
- A safety and technical inspection
- Contest slots, which teams should not expect to receive until they check in at the event, including:
    - Tunnel testing practice
    - Tunnel testing and makeup testing
    - A Project Development presentation
    - A Turbine Design question-and-answer session
    - A Connection Creation Contest presentation.

Event Registration

All individuals attending the event will be required to register with the organizers. The number of individuals that can attend from each team will be limited based on constraints such as event space. This limit will apply to all attendees from each university, including students, faculty advisors, and mentors. The limit for attending participants for the 2024 event will be provided closer to the competition date.

Lodging

CWC organizers will coordinate with the conference organizers to provide information to teams on lodging options. It is up to each team to ultimately book appropriate accommodations.

Local Resources

Each team is responsible for considering what local resources may be needed and identifying reasonable options near the event. These resources may include:

- Printing shops
- Shipping services
- Hardware stores
- Machine shops
- Electronic supply stores.

Team Booths

Teams will be provided with a space to use as their home base during the competition. There will be electrical outlets in the team booth area to allow students to operate tools, test equipment, or use computers. Appropriate personal protective equipment should be worn in the team booths when working on the wind turbines (see Appendix I for more details). Posters are encouraged to be displayed within the team booth throughout the event (easels and backboards will be provided). Additional materials that display the team's hard work and school spirit are also encouraged.

Shipping

It is each team's responsibility to transport their wind turbine and all supplies to the event safely and on time. It is also each team's responsibility to arrange return transport of those items. It is advised that teams consider how to ensure access to these items quickly upon arrival at the event and the safest way to transport fragile items, minimizing risk of damage. Shipping information will be provided before the competition event.

Storing Items at the Event

Organizers are not responsible for the security of supplies stored at the event space. If teams wish to avoid transporting supplies to and from the event each day, they are advised to explore reasonable options to store and secure those items appropriately. Gear that could aid in this might include lockable totes.

Feedback

Throughout the organization and execution of the event, organizers will request feedback from participating teams, reviewers, volunteers, and others. This feedback is taken very seriously both during the year and for future competitions as we work to improve the organization and execution of the event. To support that continued improvement, it is crucial that participating teams seriously consider and convey both positive and critical feedback. All participants should expect and plan to provide feedback at the conclusion of the event. Consider opportunities to capture and provide individual and/or team feedback to organizers throughout the year as well.

Appendix I. Safety and Conduct

The Collegiate Wind Competition is a forum for students with an interest in wind energy to showcase their innovative ideas and demonstrate their knowledge. The event is designed to be safe, fair, and competitive, as well as a fun learning experience and professional growth opportunity. Each team is responsible for the safety of its operations in accordance with the subcontract agreement. Each team member must always work in a safe manner during the competition. Participants are expected to conduct themselves in the spirit of the competition by being team players both within their own teams and among competitor teams.

Teams must follow applicable safety and health rules (e.g., Occupational Safety and Health Administration for safety equipment based on expected activities). Organizers may issue a stop work order at any time during the project if a hazardous condition is identified.

Personal Protective Equipment

All team members must wear appropriate personal protective equipment when working on, testing, and operating wind turbines. Teams are expected to use the following appropriate protective equipment during wind tunnel testing and other potentially hazardous activities at the competition (note that all of these items must be student-provided):

- Safety glasses
- Steel-toed boots if expecting to handle heavy loads[19]
- Electrical personal protective equipment if electrical voltage demands it.

Testing Hazards

Teams may encounter hazardous conditions while testing their turbines. Some examples of these conditions and safety controls that teams should follow are listed in Table I-1.

[19] Teams should use their judgment for steel/composite safety-toed shoes. If there is any danger of foot injuries due to a falling or rolling object or objects piercing the sole, safety shoes should be worn. Steel toes are usually rated for 50 pounds dropped from 18 inches.

Table I-1. Suggested Hazards and Controls for Testing Prototype Wind Turbines

Hazard	Control
Inexperience with potentially destructive testing (Testing a rotor to failure can be hazardous to people nearby.)	• Work with the faculty advisor to determine appropriate safety measures for reducing the potential for injury. • Consult the local safety department to determine appropriate hazards and safety control strategies specific to the team's campus and testing area that meet the school's requirements.
Electrical shock (A shock from contact with energized conductors)	• Follow the team's campus electrical safety requirements. • Only work on de-energized systems. • Lock the system so that it cannot be turned on or start moving inadvertently while someone is in contact with the rotor and test equipment.
Noise (A rotor assembly coming apart can create a loud, sudden burst of sound.)	• Wear appropriate hearing protection, such as approved ear plugs or earmuffs, in the test area. • Follow manufacturers' recommendations for proper usage.
Hazards to the eyes, face, and head (Projectiles could be thrown with great force from a rotor or component undergoing testing, injuring a person's eyes, face, or head [if debris takes a parabolic trajectory].	• Wear eye protection marked with a Z87+ symbol around the rotor and test area. • Information regarding eye protection can be found here: https://www.grainger.com/content/qt-personal-protective-equipment-requirements-125 • Wear hard hats if there is potential for injury to the head from falling objects; for more information, visit: https://www.grainger.com/content/qt-241-hard-hat-requirements.
Thrown debris (A rotor assembly will come apart with great force, sending projectiles into the surrounding test area.)	• Check the area to ensure it is clear before moving into the test phase; notify everyone involved that testing is about to begin. • Keep people away from the rotor during testing at what the team has determined to be a safe distance with appropriate barriers to keep others out; the barriers should have signage describing the hazard. • Station spotters around the perimeter of the area where the test is being conducted to prevent someone unfamiliar with the hazards of the test to inadvertently enter into a hazardous area. • Develop controls that allow testing to be done remotely at a safe location and to safely shut down the test. • Determine if equipment in the area could be damaged and protect it accordingly. • Determine if there are pressurized gas cylinders, hydraulic systems, or chemical storage containers that could be damaged during the test and if they need to be moved or protected. • Create housing surrounding the plane of rotation that can withstand the forces of the rotor coming apart. ○ The National Renewable Energy Laboratory uses 0.5-inch-thick polycarbonate. • Keep the area downwind and upwind clear of people where debris could be thrown with the direction of airflow or from sudden ricochets.

Sustainability

As part of the U.S. Department of Energy's and National Renewable Energy Laboratory's mission, renewable energy and sustainability go hand in hand. It is a common public perception as well. As a result, the competition is about renewable wind energy, and we expect that participants will embrace and showcase sustainability, where possible, during all aspects of the event (e.g., reducing waste in packaging for shipping, reusing packaging materials that were used in transporting items to the competition, and eliminating the use of nonrecyclable materials such as foam packing peanuts). In addition, we encourage team members to engage in common sustainable activities such as recycling paper and beverage containers. Team creativity to support this mission is encouraged.

Appendix J. Dispute Resolution

Disputes are a serious matter and will be treated as such. Disputes of score, evaluation, processing or similar must:

- Be submitted to a Prize Administrator by the student team lead
- Be submitted via email and accompanied by an in-person notification or text message
- Include a clear description of the action being protested, referencing the appropriate section of this Official Rules document.

Once submitted, the Prize Administrators will initiate an internal review of the dispute. Disputes will be discussed among at least three reviewers and/or competition organizers who will gather appropriate information through interviews or other means, and a final ruling will be issued. If it is concluded that the issue has a broader impact on the entire competition, the Prize Administrators will consult with all necessary members of the U.S. Department of Energy/National Renewable Energy Laboratory organizing team to determine next steps.

If the competition judge makes a decision that may directly or indirectly affect the strategies of some or all of the teams, the decision will be recorded in the HeroX Challenge Forum (discussed further in Appendix D) within 24 hours. If the dispute is being handled during the competition event, an announcement at the next major address to teams (e.g., opening or closing remarks for the day, lunch) may be substituted for the Slack channel post.

In all cases, the designated individual from the Prize Administrators has the final say in all disputes. All decisions are final and are not appealable. **Neither the U.S. Department of Energy nor the Prize Administrators will arbitrate, intervene, advise on, or resolve any matters between team members.**

Appendix K. Alternative Competition Structure

In the event the in-person conference is cancelled, the following updates to the competition structure will go into effect and are listed in reference to their respective sections of the main document. Should there be extenuating circumstances for some but not all teams, a hybrid solution between a standard contest and what is described in this appendix may be developed and further communicated to the teams with as much advance notice as feasible.

The following modifications are designed to accommodate the possibility that the competition may not occur in person.

In the event an individual team unable to complete any of the submissions because of extenuating circumstances, please reach out to the Prize Administrators. The primary goal of the competition is to maximize learning, and the Prize Administrators will work with each team to determine what is possible.

Background

Competition requirements for the wind turbine will be updated to reflect an effective, **digital-only,** mechanical, electrical, and aerodynamic wind turbine design that is safe and reliable for testing in an on-site wind tunnel. (The turbine need not actually be tested but should be designed as if it were going to be and subcomponents built and tested to the best of the teams' abilities according to the submissions.)

Competition, Contests, Submissions, and Awards

All references to the in-person competition presentations and question-and-answer (Q&A) sessions will shift to virtual execution. There will be no in-person turbine testing or designing of a wind farm during the competition. The planned scores for those sections will not be part of the competition scoring.

Submission Deadlines

The virtual competition sessions will be held in May or June 2024, and specific dates will be selected based on team and judge availability. If any team is unable to make the available dates or complete the submissions as outlined, they must reach out to the Prize Administrators to work out an alternative.

The expected submissions and the associated timeline will remain the same, except as shown in Table K-1.

Table K-1. Updated Submission Timelines

Submission	Submission Deadline
PRIOR TO COMPETITION:	
Unchanged	
DURING COMPETITION:	
Project Development PowerPoint presentation (digital)	Presented on virtual meeting platform
Turbine design question-and-answer supporting materials (optional)	Presented on virtual meeting platform
Connection Creation PowerPoint presentation (digital)	Presented on virtual meeting platform

Awards

Awards will shift to include:

- **A first-place winner**. This is the team that earns the highest combined score (not including the Turbine Testing contest).
- **A second-place winner**. This is the team that earns the second-highest combined score (not including the Turbine Testing contest).
- **A third-place winner**. This is the team that earns the third-highest combined score (not including the Turbine Testing contest).
- **A Project Development contest winner**. This is the team that earns the highest combined score from all Project Development submissions.
- **A Turbine Digital Design contest winner**. This is the team that earns the highest combined score from the digital design and submissions.
- **A Connection Creation Contest winner**. This is the team that earns the highest combined score from all industry and community engagement submissions.

Note: There will be no Turbine Testing contest, but there will still be an overall competition winner.

Final scores and rankings for the modified Project Development and design contests will be shared with all participants.

Turbine Digital Design Contest

The Turbine Design Contest will remain unchanged except that presentations will move to a virtual format. Presentation dates may change.

Midyear Project Submissions

All submissions and due dates will remain unchanged. They are designed to be conducted in an entirely remote learning environment, if necessary.

Private Q&A Session

The Q&A session will continue as planned, albeit in a virtual format.

Presenters should showcase their wind turbine prototype as it exists, if possible, and have the option to use PowerPoint slides or other visual aids to engage with the judges. Note that visual aids will not be scored but can be used, if necessary, to help clarify any questions the judges may have after reading the written report. See below for virtual presentation best practices and to ensure it will function as intended in advance of presentation time.

Turbine Testing Contest

This contest will become optional remote testing, and wind turbines will not be tested in the competition wind tunnel. Testing will not be scored. Teams are encouraged to test their turbines remotely, using their own facilities, and to document their testing in a short video and present their results via an informal, unscored, public-facing webinar to celebrate this year's student accomplishments. Participating teams will have the option to:

- Conduct remote turbine testing. Teams should attempt to replicate as many of the tasks per Section 3.3 as they can, including:
  - Power performance
  - Controllability
  - Safety
  - Durability
- Use the data they collect from their work on the submissions as a start on the remote testing
- Reach out to the Prize Administrators via the HeroX Forum for advice on experimental design and instrumentation selection
- Conduct testing at a time most convenient for members, taking into consideration schedules, when resources are available, and the required submission deadline
- Document turbine testing results using photos, video, screenshots, and real-time data logging compiled into a single, edited video no longer than 5 minutes in length, detailing the:
  - Turbine components
  - Experimental setup and instrumentation
  - Testing procedures
  - Results
- Optional: submit a bloopers reel, which does not count as part of the time limit, in a separate file(s).

Final submission deadline for the video will be provided during the transition to the virtual event but will be shortly before the event itself. This approach is meant to balance the time needed for teams to test with the time needed for reviewers.

Teams who submit a video summary of their turbine testing results will have the option to present their video in an interactive, public-facing webinar session as part of the Collegiate Wind Competition. These virtual sessions are designed to foster deeper learning among participants through direct feedback from the judging panel on the performance of their wind turbine, as well as through interaction with other competitors and the public. Each webinar session will include:

- A review of the submitted video
- Questions from the judges about the team's testing approach as well as feedback on the execution of testing and results
- A brief Q&A with the team, judges, and audience.

Project Development Contest

The Project Development contest, initially structured as two parts, will now only include Part A. Requirements associated with Part B will be removed from the competition.

Poster requirements will be replaced by a PowerPoint presentation, which must be delivered on a virtual meeting platform. Each team must submit their written report and PowerPoint presentation digitally.

Connection Creation Contest

This contest will remain unchanged except that presentations will move to a virtual format. It has been designed to be completed in an entirely remote learning environment. Presentation dates may change.

Rubrics

The rubrics will remain unchanged except for removing the scoring of the Turbine Testing contest and designing a wind farm during the competition as part of the Project Development contest.

Logistics

The most up-to-date logistics information will be provided to the teams directly from competition organizers.

Event Schedule

The event schedule will be provided to participating teams once it has been finalized. Slots will be determined based on preferences provided by each team in a poll, and organizers will do their best to accommodate those preferences based on judge availability. These slots are not guaranteed. Assigned slots will include:

- A Project Development presentation
- A turbine digital design session and Q&A
- A remote testing review session
- A Connection Creation Contest presentation
- A final awards ceremony.

Virtual Event Login

For teleconferencing best practices, all individuals participating in the virtual presentations should review the Virtual Networking and Career Development section.

Any members of the team, including faculty advisors and mentors, are welcome to observe their team's presentation sessions and the final awards ceremony.

Virtual login information for private presentation sessions, access to the event app, and the awards ceremony will be provided closer to the assigned competition date.

Virtual Networking and Career Development

In lieu of attending an in-person conference, upon request, organizers will set up virtual meet-and-greet activities and informational interviews with industry representatives for any interested students. If any team members are interested in this opportunity, connect with the Prize Administrators to schedule a time prior to the assigned virtual presentation slot.

Organizers will also develop a video montage to feature each team's successes. Everyone's involvement is encouraged so it can highlight the wind energy experience gained, the breadth of students involved, and the continued dedication to learning. This video will be shared on available channels to wind energy professionals, where possible; students will be able to share it as well. It is designed to highlight the skills each team developed over the course of the academic year. More information on scheduling, best recording practices, and specific questions will be provided directly from organizers.

Dispute Resolution

Dispute resolution procedures are unchanged.

Communications and Contest Details

Meetings will no longer be held during the event at the start and end of each day.

Teams will have the opportunity to set up virtual meet-and-greets and informational interviews with industry experts by coordinating with Prize Administrators. Requests for these meetings must be submitted via the Slack channel or email at least 5 days prior to the virtual competition date selected.

Given the shift to a virtual competition, teams can sign up for individual virtual interviews with the Prize Administrators so they will have the opportunity to share their story of how they continued working on the competition and what they learned during the year. Those interviews will be recorded and disseminated after the conclusion of the competition to share the teams' accomplishments with the industry.

Virtual Conference Participation Etiquette

The following best practices are highly recommended for remote participation in any event. Teams should:

- Be responsible for knowing their meeting point of contact and ensuring that connections and technology all work prior to their start time. Test the internet connection, audio and video capabilities, and ability to use the virtual meeting program before the presentation time. The organizers have built in transition time, but it is limited.
- Use a hard-wired internet connection (i.e., ethernet cord). Wi-Fi connections can be used but are not ideal because they are prone to more connection issues.
- Mute the audio connection (phone and/or computer) when the speaker is not intending to speak. The Prize Administrators will mute participants with excessive background noise.
- Ensure there is only one audio connection being used. Connect to audio via phone or computer, but not both. Connecting with two audio connections results in electrical feedback that is very uncomfortable for all involved.
- Feel encouraged, but not required, to use the team's webcam for presenting. Audio narration of slides is also acceptable.
- Ensure there is a clean background while streaming video (e.g., no inappropriate or offensive images in the background, or people walking around).
- Avoid window backdrops because of lighting.
- Be sure to dress and speak professionally during the presentation.

Refrain from distracting behavior while sharing the video and/or audio, such as drinking or eating.

Appendix L. Additional Terms and Conditions

L.1 Verification for Payments

The Prize Administrators will verify the identity and role of all competitors before distributing any prizes. Receiving a prize payment is contingent upon fulfilling all requirements contained herein. The Prize Administrators will notify winning competitors using provided email contact information for the individual, team, or entity that was responsible for the submission. A representative from the Team's lead academic institution will be required to sign and return to the Prize Administrators, within 30 days of the date on the notice, a completed NREL Request for ACH Banking Information form and a completed W-9 form (https://www.irs.gov/pub/irs-pdf/fw9.pdf). In the sole discretion of the Prize Administrators, a winning competitor will be disqualified from the competition and receive no prize funds if: (i) the person/team/entity does not respond to notifications; (ii) the person/team/entity fails to sign and return the required documentation within the required time period; (iii) the notification is returned as undeliverable; (iv) the submission or person/team/entity is disqualified for any other reason as specified in eligibility section in the executive summary or universal content section above.

In the event of a dispute as to any registration, the authorized account holder of the email address used to register will be deemed to be the competitor. The "authorized account holder" is the natural person or legal entity assigned an email address by an internet access provider, online service provider, or other organization responsible for assigning email addresses for the domain associated with the submitted address. All competitors may be required to show proof of being the authorized account holder.

L.2 Teams and Single-Entity Awards

The Prize Administrators will award a single U.S. dollar amount to the designated primary submitter (i.e., the Team's lead academic institution). The primary submitter is solely responsible for allocating any prize funds among its member competitors or teammates as they deem appropriate. The Prize Administrators will not arbitrate, intervene, advise on, or resolve any matters or disputes between team members or competitors

L.3 Eligibility

Only submissions relevant to the technical areas laid out in Section 1 and 3 of this document will be considered. The Prize Administrator has the right to refuse any submission for incompleteness or unresponsiveness to the technical topic areas.

Phase 2 is open to teams that were previously awarded as Phase 1 winners. Phase 3 is open to winning teams under Phase 2. The composition of a team may change between Phases, but must maintain participation by the same academic institution serving as the primary submitter.

A team must be comprised of:

- Undergraduate students from:
    - One or more 4-year colleges or universities in the United States.

    - A mixture of 4-year colleges or universities in the United States together with students from 2-year institutions, such as community colleges.
- A domestic U.S. academic institution serving as the lead.
    - International institutions are welcome to apply but must partner and apply with a domestic U.S. institution as the lead, with both institutions being represented at the final event. International teams will not be eligible to receive cash prizes directly from DOE and the National Renewable Energy Laboratory (NREL) and must provide their own funding to support travel and competition expenses.
- A faculty advisor from the lead U.S. academic institution.

DOE employees, employees of sponsoring organizations, members of their immediate families (e.g., spouses, children, siblings, or parents), and persons living in the same household as such persons, whether or not related, are not eligible to participate in the Prize.

Individuals who worked at DOE (federal employees or support service contractors) within six months prior to the submission deadline of any contest are not eligible to participate in the Prize.

Federal entities and federal employees are not eligible are not eligible to participate in the Prize.

DOE national laboratory employees cannot compete in the Prize.

Entities and individuals publicly banned from doing business with the U.S. government, such as entities and individuals debarred, suspended, or otherwise excluded from or ineligible for participating in federal programs are not eligible to compete.

Entities identified in Department of Homeland Security (DHS) Binding Operational Directives (BOD) as publicly banned from doing business with the U.S. government are not eligible to compete. See https://cyber.dhs.gov/directives/.

Entities and individuals identified as restricted parties on one or more screening lists of the U.S. Department of Commerce, State, or the Treasury are not eligible to compete. See Consolidated Screening List. https://2016.export.gov/ecr/eg_main_023148.asp.

Individuals participating in a foreign government talent recruitment program[20] sponsored by a country of risk[21] and teams that include such individuals are not eligible to compete.

[20] Foreign Government-Sponsored Talent Recruitment Program is defined as an effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to relocate physically to the foreign state for the above purpose. Some programs allow for or encourage continued employment at United States research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

[21] DOE has designated the following countries as foreign countries of risk: Iran, North Korea, Russia, and China. This list is subject to change.

Entities owned by, controlled by, or subject to the jurisdiction or direction of a government of a country of risk.

To be eligible, an individual authorized to represent the competitor must agree to and sign the following statement upon registration:

> I am providing this submission package as part of my participation in this prize. I understand that the information contained in this submission will be relied on by the federal government to determine whether to issue a prize to the named competitor. I certify under penalty of perjury that the named competitor meets the eligibility requirements for this prize competition and complies with all other rules contained in the Official Rules document. I further represent that the information contained in the submission is true and contains no misrepresentations. I understand false statements or misrepresentations to the federal government may result in civil and/or criminal penalties under 18 U.S.C. § 1001 and § 287, and 31 U.S.C. §§ 3729-3733 and 3801-3812.

L.4 Submission Rights

By making a submission and consenting to the rules of the challenge, a competitor is granting to DOE, the Prize Administrators, and any other third parties supporting DOE in the challenge, a license to display publicly and use the parts of the submission that are designated as "public" for government purposes. This license includes posting or linking to the public portions of the submission on the challenge website, DOE websites, and partner websites, and the inclusion of the submission in any other media worldwide. The submission may be viewed by the DOE, Prize Administrators, and reviewers for purposes of the challenge, including but not limited to screening and evaluation purposes. The Prize Administrators and any third parties acting on their behalf will also have the right to publicize competitors' names and, as applicable, the names of competitors' team members and organization, which participated in the submission on the challenge website indefinitely.

By entering, the competitor represents and warrants that:

1. Competitor's entire submission is an original work by competitor and competitor has not included third-party content (such as writing, text, graphics, artwork, logos, photographs, likeness of any third party, musical recordings, clips of videos, television programs or motion pictures) in or in connection with the submission, unless (i) otherwise requested by the Prize Administrators and/or disclosed by competitor in the submission, and (ii) competitor has either obtained the rights to use such third-party content or the content of the submission is considered in the public domain without any limitations on use.
2. Unless otherwise disclosed in the submission, the use thereof by Prize Administrators, or the exercise by Prize Administrators of any of the rights granted by competitor under these rules, does not and will not infringe or violate any rights of any third party or entity, including, without limitation, patent, copyright, trademark, trade secret, defamation, privacy, publicity, false light, misappropriation, intentional or negligent infliction of emotional distress, confidentiality, or any contractual or other rights;
3. All persons who were engaged by the competitor to work on the submission or who appear in the submission in any manner have:

a) Given the competitor their express written consent to submit the submission for exhibition and other exploitation in any manner and in any and all media, whether now existing or hereafter discovered, throughout the world;

b) Provided written permission to include their name, image, or pictures in or with the submission (or, if a minor who is not competitor's child, competitor must have the permission of the minor's parent or legal guardian) and the competitor may be asked by the Prize Administrators to provide permission in writing;

c) Not been and are not currently under any union or guild agreement that results in any ongoing obligations resulting from the use, exhibition, or other exploitation of the submission.

L.5 Copyright

Each competitor represents and warrants that the competitor is the sole author and copyright owner of the submission; that the submission is an original work of the competitor or that the competitor has acquired sufficient rights to use and to authorize others, including DOE, to use the submission, as specified throughout the rules; that the submission does not infringe upon any copyright or any other third-party rights of which the competitor is aware; and that the submission is free of malware.

L.6 Challenge Subject to Applicable Law

All challenges are subject to all applicable federal laws and regulations. Participation constitutes each participant's full and unconditional agreement to these Official Challenge Rules and administrative decisions, which are final and binding in all matters related to the challenge. This notice is not an obligation of funds; the final award is contingent upon the availability of appropriations.

L.7 Resolution of Disputes

The U.S. Department of Energy is solely responsible for administrative decisions, which are final and binding in all matters related to the challenge.

Neither the U.S. Department of Energy nor the Prize Administrators will arbitrate, intervene, advise on, or resolve any matters between team members or among competitors.

L.8 Publicity

The winners of these prizes (collectively, "winners") will be featured on the DOE and NREL websites.

Except where prohibited, participation in the challenge constitutes each winner's consent to DOE's and its agents' use of each winner's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media worldwide, without further permission, payment, or consideration.

L.9 Liability

Upon registration, all participants agree to assume any and all risks of injury or loss in connection with or in any way arising from participation in this challenge. Upon registration, except in the case of willful misconduct, all participants agree to and, thereby, do waive and release any and all claims or causes of action against the federal government and its officers, employees, and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential, and whether foreseeable or not), arising from their participation in the challenge, whether the claim or cause of action arises under contract or tort.

In accordance with the delegation of authority to run this challenge delegated to the director of the Wind Energy Technologies Office, the director has determined that no liability insurance naming DOE as an insured will be required of competitors to compete in this competition per 15 USC 3719(i)(2).

Competitors should assess the risks associated with their proposed activities and adequately insure themselves against possible losses.

L.10 Records Retention and Freedom of Information Act

All materials submitted to DOE as part of a submission become DOE records and are subject to the Freedom of Information Act. The following applies only to portions of the submission not designated as public information in the instructions for submission. If a submission includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the submission. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for review of the submission or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

The submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets.

Competitors will be notified of any Freedom of Information Act requests for their submissions in accordance with 29 C.F.R. § 70.26. Competitors may then have the opportunity to review materials and work with a FOIA representative prior to the release of materials.

L.11 General Conditions

DOE reserves the right to cancel, suspend, and/or modify the contest, or any part of it, at any time. If any fraud, technical failure, or any other factor beyond DOE's reasonable control impairs the integrity or proper functioning of the contests, as determined by DOE in its sole discretion, DOE may cancel the contest. Any performance toward contest goals is conducted entirely at the risk of the competitor, and DOE shall not compensate any competitors for any activities performed in furtherance of this prize.

Although DOE may indicate that it will select up to several winners for each contest, DOE reserves the right to only select competitors that are likely to achieve the goals of the program. If, in DOE's determination, no competitors are likely to achieve the goals of the program, DOE will select no competitors to be winners and will award no prize money.

DOE may conduct a risk review, using Government resources, of the competitor and project personnel for potential risks of foreign interference. The outcomes of the risk review may result in the submission being eliminated from the prize competition. This risk review, and potential elimination, can occur at any time during the prize competition. An elimination based on a risk review is not appealable.

L.12 Program Policy Factors

While the scores of the expert reviewers will be carefully considered, it is the role of the prize administrators to maximize the impact of challenge funds. Some factors outside the control of competitors and beyond the independent expert reviewer scope of review may need to be considered to accomplish this goal. The following is a list of such factors. In addition to the reviewers' scores, the below program policy factors may be considered in determining winners:

- Geographic diversity and potential economic impact of projects.
- Whether the use of additional DOE funds and provided resources are non-duplicative and compatible with the stated goals of this program and the DOE mission generally.

- The degree to which the submission exhibits technological or programmatic diversity when compared to the existing DOE project portfolio and other competitors.
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers.
- The degree to which the submission is likely to lead to increased employment and manufacturing in the United States or provide other economic benefit to U.S. taxpayers.
- The degree to which the submission will accelerate transformational technological, financial, or workforce advances in areas that industry by itself is not likely to undertake because of technical or financial uncertainty.
- The degree to which the submission supports complementary DOE funded efforts or projects, which, when taken together, will best achieve the goals and objectives of DOE.
- The degree to which the submission expands DOE's funding to new competitors and recipients who have not been supported by DOE in the past.
- The degree to which the submission enables new and expanding market segments.
- Whether the project promotes increased coordination with nongovernmental entities for the demonstration of technologies and research applications to facilitate technology transfer.

L.13 National Environmental Policy Act (NEPA) Compliance

DOE's administration of the Collegiate Wind Competition is subject to NEPA (42 USC 4321, et seq.). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at http://nepa.energy.gov/.

L.14 Return of Funds

As a condition of receiving a prize, competitors agree that if the prize was made based on fraudulent or inaccurate information provided by the competitor to DOE, DOE has the right to demand that any prize funds or the value of other non-cash prizes be returned to the government.

ALL DECISIONS BY DOE ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CHALLENGE.