

29th WERC Environmental Design Contest

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PARTICIPATION GUIDE



Design Contest Participation Guide

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FOREWORD

This is written for the university contestants of the WERC Environmental Design Contest (the Contest). It is updated each year based upon feedback from the judges and contestants. *All contestants are encouraged to review this document each year to assure proper preparation for participation in this unique educational experience.*

When learning a new game, one can read and understand the rules, but strategies come only with experience, either learned through trial and error, or from a mentor. This Contest is an educational experience that has been designed to simulate actual career challenges. However, like the problems you will face in your career, it requires a strategy, recognition of the boundaries associated with the task, identification of a path forward, and a personal commitment to follow through on the task.

First, this handbook is intended to establish a common basis for participation by all contestants. Second, it should provide a platform for the creative process to grow and flourish. Third, by taking advantage of feedback from the judges, new contestants will have the same chance of winning as experienced contestants. *All the information you need to achieve superior results in the Contest is contained within this handbook.*

Throughout this document, you will find valuable guidance on how to prepare for the Contest and common performance errors observed by past judges. The judges have provided this information to help you obtain the maximum benefit from the Contest in ways that will enhance your future career. This document is also designed to remind those contestants whose universities have previously competed of the parameters within which this Contest is held.

BACKGROUND

WERC was established in 1990 under a cooperative agreement with the U.S. Department of Energy. Since 1991, WERC has conducted an annual environmental design Contest for university students.

The term “universities,” as used in this handbook includes community colleges, junior colleges, four-year institutions, and graduate programs. Although WERC recognized that undergraduate and graduate educational programs throughout the world focus on environmental management, science, and engineering, there was no vehicle to bring students together from various universities to discuss major environmental issues or develop solutions for specific environmental problems. Consequently, WERC established this unique, successful, and innovative Contest to meet that educational and experiential need.

The Contest is structured to give student groups from around the world an opportunity to exchange information and participate in an international competition. The goal of the competition is to design, develop, and test actual environmental processes for real-world problems. Typically, the environmental tasks presented have no known solution, or the available solutions do not meet the desired performance criteria.

The creators of the Contest want to provide the contestants with a professional learning experience that is usually available only after graduation. Hundreds of entrants have commented that the Contest was among the best experiences of their university career. Enhancing the total university experience is the main goal of the Contest. Winning is important, but winning is not the main goal of the Contest.

A CAREER LEARNING EXPERIENCE

After college, you will undoubtedly have opportunities to make presentations to senior managers or clients. This is a standard process used by most businesses, government, and other institutions to justify expenditures for an endeavor. You will probably not know some of the decision-makers. Rumors may abound on the personalities involved, but in the final analysis, you will depend upon your knowledge, skills, common sense, creativity, and clarity in preparing and presenting your ideas. Common sense is generally based upon experience, and the Contest is designed to give you relevant experience that you will apply throughout your career.

The Contest has a moderate stress level. In your career, the stress will be higher. For example, your Contest paper will be read in full by the judges, and you will be allowed to make your oral presentation without interruption. Keep in mind that today's managers are very busy with extremely limited time for meetings. In career situations, most of the people who will be making the decision on your idea may have read only your report summary. In addition, you may be promised 20 minutes for your presentation, but you may only get 5 or 10 minutes and be interrupted numerous times. Also, in a career situation, there may be people in the audience who want you to fail because it competes with their own "pet project."

The Contest prepares you for your career in several ways. First, it gives you a business experience in a competitive environment prior to leaving school. Your career will be competitive, and the criteria by which you are judged may never be fully known. Second, a set of judges has been assembled with many years of experience in the vary activities you are experiencing via the Contest (i.e., the process of creating and selling an idea in a competitive environment). This gives you the opportunity to interact with some of the most knowledgeable scientists and engineers in your field, before you start your career. Finally, the Contest prepares you by judging your Contest performance with both

objective (quantitative) and qualitative criteria. This is an experience that will be repeated many times in your career.

WHO IS INVOLVED

The Contest is open to any two-year, four-year, or graduate institution. The competitors are self-selected and may come from anywhere in the world.

The Contestants

Each team is comprised of several students and a faculty advisor. In the past, teams have entered with as few as two students. The number of students that appear for the Contest is not nearly as critical as the composition of the students involved in the task. The tasks are established to require a multidisciplinary team. In industry, almost all problems are approached with a multidisciplinary team and working on such a team is part of the Contest learning experience. Carefully read the Detailed Information on each task (including any Attachments) to determine what skills are needed to establish your team.

A common error is to compose the team of only technical people because the problem is technical. Consequently, many papers are weak in the areas of economic, social, and regulatory analysis. Other common weaknesses occur in the business plan and safety considerations. Students who have completed classes in cost estimating, accounting, public administration, communication, journalism, business, safety, or environmental law may be an asset to your team. Again, we want to emphasize the advantage of a properly assembled multidisciplinary team.

Another consideration in the composition of your team is the grade year. Although some teams are composed of students in the same year, other teams have students ranging from freshman through the graduate level. The latter teams have at least one advantage. One or more members will be available the next year to mentor a new team.

The Judges

The average judge has 15 to 20 years' experience in his or her field and is a leader within his or her professional community. The judges come from all walks of life and different backgrounds. There is no common professional language or experience base between the judges. This is a deliberate attempt to model today's diverse industrial environment. A broad base of judges is needed because judging the Contest requires expertise in the physical and biological sciences, engineering, business, economics, health and safety regulations, environmental regulations, public policy, and communications. By merging their skills, the judges become a multidisciplinary team capable of evaluating the efforts of the multidisciplinary contestant teams. Each judge brings his or her unique career experiences and perspective to the judging.

The Faculty Advisors

Your faculty advisor is an integral part of your contest team and provides an invaluable liaison between your university and the WERC staff on all aspects of the Contest. Your advisor typically represents a strong measure of continuity from year to year in regard to the logistics, rules, and procedures of the Contest. He or she also knows the policies or practices of your university. Your advisor is the expert on how to identify and acquire appropriate funding, equipment, services, and interdisciplinary cooperation. He or she can also advise you on the technical merits of your design and how you should advance through each stage of your project.

Your advisor should be a strong influence in setting goals and keeping your project moving at an appropriate pace to assure its completion within the time frame specified by the Contest rules. Be sure to work closely with your advisor, especially when open-ended questions arise about your chosen task. If your advisor is unable to give you an answer, he or she can contact the appropriate person(s) at WERC to obtain the needed information.

The judges have noted that a close relationship between the contestant team and their faculty advisor contributes to the success of the team. Work closely with your faculty advisor. Unless this is your university's first year to compete, your faculty advisor is the person most likely to provide initial mentoring. A significant part of this learning experience is obtained through the relationships you establish with your faculty advisors. The judges have noted that teams accompanied by their advisor throughout the Contest generally perform significantly better than teams whose advisors do not attend.

THE FOUR PARTS OF THE CONTEST

The Contest is conducted in four parts:

- (1) A paper that presents a full-scale process analysis and design,
- (2) An oral presentation,
- (3) A bench-scale process demonstration (with samples taken of the product for analysis), and
- (4) A poster board presentation.

All four of the above Contest "elements" are part of a process used to communicate and advance ideas and projects toward implementation in today's business environment. The judges have provided feedback on the most common errors and omissions observed in each element of the Contest. It is recommended that you use this information to assure a high score.

The Design Paper

The points available for the design paper represent 30% or almost one-third of your potential total score.

Many teams find the development work more enjoyable and start on the paper too late. Remember the old saying about the importance of first impressions? Your team's full-scale process design paper is the first thing that the judges see. The judges report that they spend from one to two hours reading and evaluating each paper while constantly checking it against the judging criteria. In addition, after a judge has read your paper, he or she will read several more on the same task. Each judge will decide which of the papers he or she reviewed is best.

If you want to make the best first impression, do your homework:

- Conduct a thorough literature search,
- Define a specific approach to the task solution,
- Evaluate all possible process alternatives,
- Perform additional library research on the selected option,
- Develop a written action plan,
- Develop your process,
- Summarize the data,
- Write the design paper,
- Review the paper to assure it contains the required elements,
- Have independent reviewers provide detailed editorial and technical feedback,
- Incorporate the reviewer's comments into your paper and process, and
- Submit your design paper on time.
- Please include the date and year of the contest, the task that you are doing and the names of the participants on the front inside cover.

The task statement for the design paper may require writing all or some of the following sections and parts for the design paper:

- ***An Executive Summary***

The executive summary section of your paper is extremely important. It should provide an overview of your entire project and paper. Any reader should be able to understand the task assumed, the options considered, the process selected, the projects cost, performance, and schedule, and the conclusions reached. This section is often used as a reference for the judges. It should be concise.

Judges frequently note the following deficiencies in executive summaries:

1. Copying the problem statement from the provided materials instead of restating it concisely in a manner that reflects knowledge about the problem.
 2. Devoting too much space to the task problem. In many executive summaries, the problem statement was over half of the length of the summary.
 3. The executive summary is too short. These summaries failed to cover all the parts of the paper in a brief, concise manner. The summary should be a stand-alone document that fully summarizes the paper.
 4. The executive summary is too long. As a summary, it should be succinct.
- ***A Body of the report should include:***
 1. A discussion of the technology alternatives considered for the task
 2. A discussion of the full-scale design based upon the bench-scale development and laboratory results
 3. A business plan with cost, schedule, and performance data.
 4. A discussion of health, safety, and environmental regulations
 5. A community relations plan

The body of the paper provides the details of your project. It must be complete and written in a logical order that leads the reader to your team's conclusions.

A discussion of the technology alternatives considered is often missing in contestant design papers. This section of the report should cover all the technologies considered and reflect the logical thought process by which your team selected a technology for the full-scale design. The judges commonly observe the following deficiencies:

1. Insufficient library research for viable technology alternatives.
2. No discussion of the pluses and minuses for each technology considered.
3. No logical flow leading to the technology selected; i.e., a weak justification for the technology selected.
4. No discussion of laboratory-scale experimentation, where applicable to the final technology selection; i.e., no engineering alternative process research supporting the final selection.
5. After selection of the technology for the full-scale process, failure to provide sufficient laboratory data to validate the choice.

The discussion of the full-scale design should reflect the logical process that led from the development of your bench-scale process to the full-scale design. The judges have frequently noted the following deficiencies with respect to the full-scale design section of the paper:

1. The most common error was not addressing all the required topics, including task specific requirements, outlined in the problem statement.
2. Failure to read and understand the details of the task problem statement. Consequently, failure to properly define the task.
3. Failure to apply fundamental engineering principles and concepts.
4. Failure to show in a logical manner, how the solution meets the requirements.
5. Poor documentation of the laboratory set-up and results.
6. Failure to provide sufficient data to reflect an understanding of the task and its solution.
7. Not enough research into the background/history of the problem. Tackling unfamiliar subjects, such as radioactively contaminated materials, and failing to educate your team on the basics of radiation.
8. Failure to address the special concerns outlined in the problem statement (i.e., health & safety, regulatory, economics, radioactivity, etc.).
9. Ignoring secondary wastes; especially hazardous secondary wastes.
10. Lack of process flow diagrams with appropriate mass and energy balances.
11. Failure to appreciate the physical and chemical problems of scale up.
12. Designing processes that can not be scaled up from bench-scale to full-scale because of inadequate consideration for health, safety or environmental hazards.
13. Confusion between the bench-scale and full-scale process. There may be significant differences between the bench-scale and full-scale process if surrogates were used for the bench-scale.

Weigh and balance the hazards in your bench-scale and full-scale process. One common error is to exaggerate one hazard over another (e.g., being overly concerned about traces of plutonium when the real threat is a hazardous chemical present in the mix). Conversely, radiation at potentially lethal levels generally makes the presence of other hazardous substance immaterial. There is no predetermined answer to this technical issue and the problem will be just as relevant if you are considering one chemical against another. The answer will depend on many factors, which you must understand and evaluate on a case-by-case basis.

The business plan is critical to your design. No manager will support construction of a facility or process that is not economically sound. The judges have commonly noted the following deficiencies in business plans:

1. No project and construction schedules.
2. No references for critical market costs.
3. No life-cycle cost analysis. Teams generally use a construction project approach that is too limited.
4. Insufficient detail - cost elements such as overhead, maintenance, labor, utilities, operations, and equipment are not broken out.

5. Poor documentation of cost information. No sources are provided but cost “estimates” are often stated to the nearest penny.
6. Limited investment decision information and/or no return-on-investment calculations.
7. Costs that are not compared with the cost of a current baseline technology.
8. A lack of understanding of the relationship between cost and the potential for implementation of a process.
9. Failure to understand the relationship between cost and regulatory impacts such as negotiations and redesign.
10. No costs attributed to engineering development.

The area of the regulatory impacts on the cost, schedule, and overall feasibility of a process is often weak. If there are standards with abnormal impacts on the process, design, or waste streams, be sure to note the impacts and how you plan to reduce or mitigate these impacts. This is one area where a technical reviewer from industry could be a valuable advisor to your team.

The health, safety and environmental section of your paper should provide an overview of applicable regulations. However, just listing the applicable regulations is inadequate. Specific pertinent issues must be identified and discussed. For example, if a process uses an explosive chemical, a discussion of the special controls to be implemented is essential.

The judges have frequently noted the following deficiencies in health, safety, and environmental coverage:

1. Many contestants know what laws apply, but fail to understand how those laws impact their project.
2. Many papers address federal regulations, but ignore state laws.
3. Failure to discuss how regulatory approval will be achieved.
4. A lack of detail on how significant health and safety issues will be handled when processing at full-scale.
5. Failure to select a viable technology due to inadequate familiarity with the hazardous materials and conditions of the project.
6. Lack of a well-rounded safety plan (i.e., physical, chemical, radiological, etc).
7. A misunderstanding of the regulatory drivers; i.e., why a certain project may need to be completed or why some technologies are not viable.

A community relations plan is not required in every case. However, if your process will bring a hazardous operation to an area where none previously existed, or clean up of hazardous materials will create a public concern about the potential for a release, it is essential that you involve the community. The most common error in this section is to tell the community what you plan to do versus

letting them provide input to the decision. Also, if a community relations plan is not required, explain why.

- ***Conclusions***

The conclusion and appendices are often overlooked. The conclusion should be brief and summary in fashion. It should simply state what you are going to do and why. The most common error is to reach conclusions that are not supported by information in the body of the report.

Each paper should have an appendix containing the audits of their design paper. When you finish your paper, you should select several reviewers, including “auditors,” with combined professional experiences covering all the elements of your paper. However, at least one reader should be a strong editor, another should have a strong technical background, and another should have no previous knowledge of the subject. When someone who knows nothing about your task can understand your paper, you will have assurance that your paper communicates the desired message.

- ***Appendices***

Appendices should be used very sparingly. Generally, only include information that is essential but is not appropriate in the body of the report; e.g., a letter quoting a price from a company willing to buy product or by-product from your process.

The judges have often noted the following deficiencies with respect to the audit section of the design reports:

1. The most significant error is not using the input from the auditors to improve the paper or project.
2. It is often clear that the professional who performed the audit did not read the problem statement.
3. Many audits are clearly form letters equivalent to a “rubber stamp.”
4. The auditors are often all professionals within the same areas of expertise. For good coverage, the auditors should come from as many multidisciplinary areas as was required for your project.
5. Audits performed by persons within the university do not have the same credibility as outside audits.

Readers selected as auditors may have more impact if they are selected from the industry that would be utilizing your technology or buying your process. It is also recommended that you not have anyone on your team perform the audits. Be

reminded that the auditors must have sufficient time to conduct their review. A paper received at the WERC office without the audit is incomplete.

While your teams' challenge is to solve a technical problem, good technical writing is equally important. A common area of weakness is the organization of the design paper. The Contest packet requires that certain information be provided. Divide your paper into sections and assure that the required information is in the proper section. If the judges have to search for this information or guess what areas in your paper provide the information, you may lose points.

The above list is not necessarily complete. Review the task problem statement carefully to assure that you have covered all the required topics. Failure to cover all the topics required by the problem statement is the most common reason for the loss of points on the design paper.

Other common errors involve text that does not communicate, illustrations that cannot be interpreted, missing data, and attempts to finesse required information in the paper. Also, clearly delineate your topics.

A good paper is a balanced paper. In summary fashion, readers should be able to follow your project from the task selection, through the options selection, the laboratory-scale results, the bench-scale results, and the full-scale process design to the conclusions of your work. No one section should overpower another.

You need results. Filling your paper with theory and concepts is insufficient. If you are not sure about a technical detail, do more research. At least one judge will be knowledgeable in your subject area; it's proof of principle that wins awards.

The judges have frequently note the following deficiencies with respect to technical writing and editing:

1. The most common problem is spelling errors. This reflects poor proofreading and a failure to use the computer's "spellchecker."
2. Failure to have the paper reviewed by a technical editor. Editing can compensate for poor writing skills.
3. Some papers are poorly organized. Poor flow distracts a reader from the logical conclusions.
4. Missing units and poorly defined quantities; e.g., 0.001 Kg versus 1 gm.
5. Misuse of terms. Be sure that you know the correct definitions of industrial terms.
6. Lack of figures, tables and illustrations. Properly used, they make a paper more readable.

7. Poor use of figures, tables, and illustrations; i.e., they did make a point or add to the clarity of the text. For example, figures that are not referenced in the text.
8. Incomplete process flow and mass balance sheets.
9. Illegible graphics. Colors and background shadings that make the graphics illegible when copied in black and white. Small fonts that do not survive multiple reproduction.

With the common use of computers there is a tendency to want to use colors and backgrounds in your paper. Your paper may be copied more than twice on a black and white copier. Resist the urge to use colored type, colored backgrounds, and small type. A judge cannot fairly assess your effort if part of it is unintelligible. Use black print on a white background for all text and illustrations.

Submit your paper on time. In the real world, late submissions are not considered. *In the Contest, late papers are penalized and points will be deducted from your score.* Such a reduction may cost you an award. Only Team Leader or Advisor should upload the written report in a PDF format to the team's account. If you have any problems with submission, please contact immediately werc@nmsu.edu or call 575-646-8171 .

The Oral Presentation

The points available for your oral presentation represent 25% or one-fourth of your potential total score.

Your presentation must be clear, concise, to the point, and easily understood. Try to put yourself in the position of a plant manager or client who is being asked by you to support development of a project based upon an oral presentation. A large part of a plant manager or client's decision will be based upon the impression you make and the confidence gained in your ability to convert your idea into dollars for the company. He or she may have several very pointed questions, and you must be prepared to answer them. Anticipate what is important and what questions will be asked, do your research, and practice your responses. The judges, like a manager or client, will usually identify a weak area in your logic or presentation and probe it.

Be prepared. You cannot be an expert on everything, but you can usually have a good answer ready if you have thought about it in advance. If you have properly assembled a multidisciplinary team, at least one member should have the needed answer. If you do not know the answer, an honest, "I don't know" is the best response. It will be obvious to the judges if you try to bluff. To make the best impression, each speaker will know who has the answer and smoothly pass the question to that teammate.

Some teams share the oral presentation, and others have only one member represent the team. The number of people making the oral presentation or answering the questions has

never been an issue. However, all the team members required to answer the judge's questions should be available near the podium.

You will be judged upon the quality of the presentation. Each speaker must be confident and comfortable with the subject and relaxed in answering questions. Changes in speakers must go smoothly. If questions are passed to another team member, that team member must not only remain poised while answering the question but also in passing a subsequent question to another team member, if such a transition is prudent.

Frequently, "flashy" presentations omit important technical data. Be sure that your slides make your points clearly.

Be sure that you are familiar with whatever projection equipment is chosen. Difficulty with your equipment may affect your presentation. It is very wise to have a "back-up" plan in the event of equipment failure.

The popularity of laser pointers has produced a new safety concern. Extreme care in the handling of laser pointers is essential. This is one of the few ways in which a safety infraction could occur during the oral presentation.

Rehearse your presentation until you are comfortable (but do not sound like your presentation is memorized) and avoid reading the presentation. Remember the plant manager's or your client's decision on whether to support or deny the project will be heavily based on the level of confidence he or she has in you at the end of your meeting. The judges come from this kind of background, and if you *know your subject* and exhibit confidence, you will make the best possible "second" impression.

The judges have often noted the following deficiencies in oral presentations:

1. Reading the slides or cue cards.
2. Failure to expand on the information contained in the slides.
3. Looking at the slide rather than making eye contact with the audience.
4. Using fonts that are too small.
5. Failure to allow adequate time for the audience to read the slides.
6. The speaker blocking the audiences' view of the slides with his or her body.
7. Failure by the speaker to project his or her voice.
8. Inappropriate use of laser pointers.
9. Ineffective use of computer projectors.
10. Oral presentation materials which are illegible or unintelligible.
11. Talking around the answer to a question. Be direct, even if it means admitting you do not know.

The Bench-Scale Demonstration

The points available for the bench-scale demonstration represent 30% of your potential total score (i.e., almost one-third the potential total score).

This is often the favorite part of the Contest for both the judges and contestants. Many judges volunteer their time because of the satisfaction they receive in interacting with you, the contestant. Have fun, but be prepared.

Rehearse your bench-scale process and poster board presentations. Are they clear and concise? Are you comfortable with the subject and can you appear to be relaxed while answering questions? These are the same issues discussed above for the oral presentation, except this time you will be in a tent with plenty of noise and people moving about your booth. There may even be floodlights, video cameras, and national media representatives present. Ignore the distractions. This portion of the Contest is designed to evaluate you under moderate stress. Where the judges did not interrupt your oral presentation, they will feel free to ask questions during your bench-scale and poster board presentations as often as necessary to get the information they need. You want to be relaxed, confident, knowledgeable, and helpful.

A common mistake is to ignore the analytical results of the bench-scale product versus the performance criteria for the task. The final criterion in differentiating between top finishing teams is sometimes whether you pass, exceed, or fail the task performance criteria based upon the analytical results from the bench-scale process.

The judges have often noted the following deficiencies with respect to the bench-scale demonstration:

1. Failure to understand the relationship between the bench-scale and full-scale process.
2. Not covering or performing the full bench-scale process (where appropriate).
3. Failure to test the adequacy of all aspects of the full-scale design.
4. Not presenting in a professional manner.
5. Poor understanding of the performance criteria.
6. Limited awareness of the sampling points and frequency.
7. Inadequate understanding of the chemistry involved.
8. Poor labeling of the bench-scale components.
9. Awareness of hazardous materials, but not the industrial hazards of the process.
10. No health & safety plan or Material Safety Data Sheets.
11. No safety procedure for the bench-scale operation.
12. Improper management of waste containers.
13. Failure to meet the basic safety requirements with respect to gloves, eyewear, etc.

The Poster Board

The points available for the poster board presentation represent 15% of your potential total score (i.e., about one-seventh the potential total score).

The poster board is about your full-scale process. Make sure that your poster board is focused, clear, easy to grasp, and makes the right points. The poster board should sell your process at a glance.

The judges have frequently noted the following deficiencies with respect to the poster boards:

1. Too much information and/or small print.
2. Lack of a logical flow that tells a visual story at a glance.
3. Failure to focus on the full-scale process versus the bench-scale process.
4. Inability to tie the bench-scale, poster, and full-scale processes together when questioned.
5. Repeating the oral rather than a fresh approach.
6. Reproducing the paper rather than a fresh approach.

Most teams have one person show the process, another present the poster board, and the whole team available to answer questions. There is no required approach. Consider in advance how your team can make the best impression.

SAFETY

In the contest, as in your career, safety should always be a part of how you operate. Each year, WERC has increased its concerns for safety. Note that the last five deficiencies identified above are all safety related. *There is no room for safety violations.*

Safety is considered and judged in two ways. First, part of your safety performance is included in the judge's objective criteria. Your score will reflect whether or not the judges observed safety violations during the bench-scale demonstration. Do not overlook correct personal protective equipment and procedures. The judges will be watching to see that you have properly incorporated safety by identifying the hazards, implementing safety controls and standards, displaying your safety permit, and demonstrating that you understand why safety is important. This includes providing the judges with safety equipment when appropriate. The second way in which you are judged on safety is discussed under **Other Considerations** below.

Safety must be considered at all times, even when the judges are not present. The easiest way to disqualify your team for a top award would be an accident, injury, or illness resulting from your actions or negligence. Receiving a safety citation during the Contest may also cost you a top award. Suppose that one team scored the most points for Best Overall, but they had been cited for safety violations. Assume the second highest scoring

team, on the objective criteria, had a spotless safety record and performed equal to the highest scoring team in all the other qualitative criteria. If you were a judge, to whom would you give the award?

Other Considerations

Other considerations are “qualitative” judgment criteria that do not result in a numerical score. For these factors, the criteria are pass/fail, but ultimately, you are compared against the performance of the other contestant teams. *Except for safety issues, these judgment criteria are only considered after the compilation of the objective (quantitative) scores and only in cases where a tiebreaker is required.*

As discussed above, safety is a major concern during the Contest. WERC safety officers will inspect your booth several times during the Contest, and citations will be issued for violations. Have your university safety officer review your bench-scale set-up before leaving for the Contest.

JUDGING FACTORS

A critical part of the Contest experience, which will be valuable to you in your career, is understanding that scoring is partially based upon the perception of the judges. The judges are relying upon years of professional experience to select the winners. However, experiential judgment does not end with the judging criteria. Some of it is subconscious. Most of the judges obtained their career experience during a period in which business was conducted in a more formal environment. Although they are dressed casually for the Contest, they come from a professional setting where certain protocols are always observed.

You should ask yourself, how am I being perceived? Am I properly groomed? Am I appropriately dressed for the portion of the Contest for which I am being judged? Do I appear confident and poised? Am I being perceived as a professional?

One of the most common mistakes is a poor attitude. *Expect things to go wrong.* How do you handle problems when they occur? Will you appear rattled? What words will you choose when answering questions or explaining the problem? How you verbalize a problem is just as important as the technical content of the problem. If you smoothly recover from an error, the judges may ignore the error based upon your response.

Another common error is attempting to manipulate or influence the judges. Every judge is careful not to allow themselves to be biased by anything other than the results of their observations and their individual judgment of your performance against the criteria as they interpret it. Any attempt to manipulate or bias a judge should be carefully avoided.

WINNING STRATEGIES

When reviewing the Contest task information, be sure assess the strengths of your university team. Select your task or tasks based on your strengths.

A common contestant concern is the development cost that goes into each task. Some universities provide the funds and keep the prize money for next year's Contest. Other universities encourage their teams to raise the funds. The prize money is either shared between the contestants or saved for the next year. Many winning teams have borrowed equipment or adapted used industrial equipment and items from a local junkyard at amazingly low cost. Other winning teams have raised money through bake sales or soliciting sponsorships from local companies. This is one part of the Contest in which WERC has no involvement. However, the judges have noted that there is no direct correlation between a team's financial backing and their ability to win. *The judges believe that the characteristics most closely related to winning are commitment and innovation.*

Commit yourself to winning. Develop a strategy that will carry you from the beginning of the task through the Contest. Start with the literature search, write an achievable action plan, design your bench-scale process, perform the work, write your paper leaving enough time for review and editing, and practice for the Contest. Do not overlook the value of innovation and making a good impression. *Half the Contest is proving the technical feasibility of your process and the other half is convincing the judges of the advantages of your approach.*

Your Contest strategy should include an early start. *The single most common error is starting late.* This results in submission of a paper that is not balanced or lacks required information. It's proof of principle that wins. Get results; prove your concept in the laboratory, then prove it on a bench scale, complete all your laboratory analyses, and then summarize your total effort in the paper.

A common error is to overlook the importance of waste minimization and secondary waste streams. If you were the judge, how would you rank a process that generated a more dangerous and/or a greater volume of waste than was originally identified? In some cases, a more dangerous waste may be acceptable if it is of low volume and you have indicated an acceptable waste management approach. There is no pre-established correct answer, but you must consider your waste streams, indicate how you will manage the waste streams, and be prepared to defend your solutions. Reading and fully understanding the task statement supplied by WERC should help you prepare for this challenge.

Be advised that the trend in industry today is to minimize or eliminate waste generation. This philosophy includes recycling waste products and the use of chemical substitution to

avoid the generation of hazardous and toxic waste where waste generation can not be eliminated.

Most of the time, innovation will win the admiration of the judges. However, sometimes it becomes a judgment call. Assume that the Contest has an environmental restoration task concerning buried contaminated building debris and the two top teams are tied. One team has a standard chemical process that is very expensive, produces a significant amount of a secondary hazardous waste, but will only take five years to complete. The tying team has an innovative bioremediation process that is very inexpensive, generates little secondary waste, but will require 50 years to decontaminate all the debris. In the second example, the public liability exposure could be significant. If you were a judge, whom would you pick for first place? There is no pre-established answer to this question. However, an innovative solution will be viewed positively by the judges, especially if it has a low life-cycle cost, generates minimum primary and secondary waste streams, presents minimum safety and health risks to the workers and the public, and meets applicable regulatory requirements.

A “First Place” Strategy

To win a first place award you must excel in the combination of your objective (quantitative) score and the qualitative criteria identified under **Other Considerations**. This includes having few judgments (preferably none) that might reduce your score. For example, late submission of your design paper, safety citations, failure to meet the performance specifications on your bench-scale process sample, or exceeding the allotted time for your oral presentation.

In the section on **Improving Your Score**, we did not share the specific criteria used by the judges to select the Contest winners. In this section we will share two key elements to a winning strategy.

Many judges have observed that the best technical solution does not always win. *The best “presentation,” coupled with a workable cost-effective solution, will often take a prize.* Presentation means how you “presented” all four elements of the Contest (i.e., the design paper, oral presentation, bench-scale demonstration, and poster board presentation). This is a part of the Contest simulation that you will experience in your future career.

Many judges have also observed that *to win first place requires a focus on excellence in all four elements of the Contest.* A common error is to focus on one or two Contest areas and let the other areas go until the last minute. *A winning strategy is to start preparing well for all four elements of the Contest from the onset.*

A “Best Overall” Strategy

Some universities enter more than two tasks. A common incorrect assumption is that you must win a first place award in two tasks. In practice, this is seldom the case. To win best overall, *you must score highly in at least two tasks and have very few judgments (preferably none) that might reduce your score.*

In evaluating the tasks, the judges first apply the objective criteria noted above, then consider the qualitative factors to determine the finalist. In cases where a qualitative factor eliminates one task (e.g. a safety citation), the judges will use that university’s next highest scoring task.

As the Contest has matured, the choice of tasks has expanded. Since the technical strengths of universities vary, it is assumed that a choice of tasks provides each university the opportunity to select those tasks that give their university the best chance to excel. Each university should carefully weigh the number of tasks selected against their ability to excel on each task. Since each task requires a multidisciplinary team, it might be better to establish two well-balanced teams than three or four understaffed teams.

The Importance of Paying Attention to Details

Remember to check your entry against the Contest requirements to be sure you are providing all the required information in your design paper, oral presentation, bench-scale demonstration, and poster board presentation. You should be clear on these requirements when you start, check your progress mid-way through, and check again before the Contest.

Are you prepared for obvious questions? A common error is to use standard research approaches or economic analysis tools without understanding why that is the best choice for the task. For example, assume one of your advisors recommended a particular economics tool for calculating depreciation. How will you answer if asked why you selected that specific tool versus other available tools? If you can answer the question in a way that is reasonable to the judges, you will have made an outstanding impression. Either having anticipated the question or having a business student on your team can make the difference.

Many judges have commented that *the Contest is seldom lost due to problems outside the control of the contestants.* Therefore, each contestant team needs to focus on those elements they can control. The technical content of your presentations, your professionalism during your presentations, and your demeanor all count toward your final score. Managing the details can be a key to success.

CONTEST ETHICS

The Contest provides you an opportunity to exhibit the ethics of your chosen profession. This section covers issues specific to the conduct of the Contest.

The Contestants

It is the intention of WERC that you have fun while learning. Try to visit all the other Contestant exhibits and mingle with other contestants and the judges during meals. Talk to your competitors and try to understand their thinking. Essentially every team has combined hard work with creativity to develop their process. Every team will have at least one idea that did not occur to your team but will be valuable to you in your career or for next year's Contest.

Approach your competitors with respect. Do not pry or spy. Be willing to share and let your competitors determine what they are comfortable in sharing. When the final judgments are known, congratulate the winners on their awards and the other teams for their unique ideas and accomplishments. Sportsmanship is an important part of the Contest learning experience.

The Judges

The judges usually enjoy the Contest as much as the students. With few exceptions, the judges eat with the students so that the students will have an opportunity to speak with them. Both the judges and the contestants are encouraged to take every reasonable opportunity to interact. An important part of the Contest experience is the mentoring the students can obtain from the judges with a little effort on the part of both parties.

The judges are bound by the WERC Contest ethic to make as objective a decision as possible on the awards. If a judge has a pre-Contest bias for or against a particular university, he or she will excuse themselves from judgment on that university. In addition, each judge will refrain from making evaluative comments on the performance or merit of a particular contestant team in front of any contestant team. If a judge should make such a comment in error, he or she will again excuse themselves from judgment on that university.

Intellectual Property

As discussed every year in the Contest announcement information, the intellectual properties resulting from the Contest belong to WERC and may be used by the sponsoring sites for their specific purposes without charge. In cases where the intellectual property is used for commercial applications, the benefits and any potential income will be equally shared between WERC and the contestant university.

Post-Contest Feedback

Often in the workplace, you will not know how a decision was made. In the Contest, all judges must work as a team to achieve consensus on the awards. Once the decisions are made, all the judges have accepted both the selected teams as winners and the basis for selection. Feedback on your performance is available after each Contest to enhance your learning experience.

How Feedback Is Provided

Most teams want to know how well they scored. Each year, you will be provided with feedback for each task in which your university participated. This feedback is brought to you in the following manner:

- The judges are asked to spread out through the awards banquet hall for the sole purpose of providing feedback to the teams. Each judge will attempt to seek out a team with which he or she is personally familiar in order to provide that team with feedback. However, the judge will not answer specific questions until after the awards have been made.
- Additional feedback is provided to you through post-Contest communications with your faculty advisor. This takes the form of providing the high score, the low score, the average score, and your score for the paper, oral, bench-scale process, and poster. Your faculty advisor will be provided this information for each task in which your university participated. Related comments from the judges, which may be beneficial to your team's future performance, may also be provided.
- WERC will provide feedback on a task by task basis after completion of the judging.

WHAT TO DO IN YOUR SPARE TIME

Most of the teams have completed the competition by Wednesday morning of the Contest and have some free time. In April, it is cool enough to comfortably visit the desert. Therefore, we suggest that you drive to the White Sands National Monument. The site is about one hour from New Mexico State University. On your trip, after you reach the top of the pass, there is a scenic area from which you can see the modern White Sands Missile Base.

When you arrive at the White Sands Historical Monument, be sure to stop at the museum near the park entrance before proceeding into the site. There is a charge to enter the park, as for all national parks. In addition, we suggest you take a lunch and water with you.

If you wish to stay in town, we suggest a visit to historic Old Mesilla Plaza. Old Mesilla is the site of the Gadsden Purchase and the trial of Billy the Kid. The route to the plaza and the location of other interesting sites can be obtained from the:

Las Cruces Visitor's Center
211 N. Water Street
Las Cruces, NM 88001
Website: www.weblifepro.com/lascruces

FOR MORE INFORMATION

The WERC staff is available to assist you or your team both before and during the Contest. If you have a specific question or problem, please contact WERC using the information below.

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For additional information, visit the Contest website at <https://wercdesigncontest.nmsu.edu/>.

CONCLUSIONS

As previously stated, hundreds of contestants have commented that the Contest was one of the best experiences of their university life. The opportunity to participate in the Contest is both a privilege and a unique experience. This is true whether you are a contestant or a judge.

The exposure of the graduating students to potential employers in the environmental field is a subtle, but real, benefit that you will only appreciate when you have sent out applications that sometimes appear to have fallen into a “black hole.” For others, the experience may provide the key to a winning project in the following years. The interaction with other participants, new friendships, and validation of your thoughts and actions among your peers are things you will cherish for a long time.

The judges volunteer their time because they believe in the career benefits of the Contest for the contestants. The judges are motivated by the belief that everyone is a winner in this Contest. The opportunity to spend a week with some of the world's finest university students is the judge's reward. Each contestant who takes the opportunity to interact with

the judges during the week of the Contest will gain additional dividends from the experience.

For many participants, this is a first trip to the Southwestern United States, a region that was the last American frontier and is rich in Hispanic and Native American cultures. The State of New Mexico has two national laboratories and several Army and Air Force bases where environmental restoration is a priority. In addition, the three state research universities (New Mexico State University, University of New Mexico, and New Mexico Institute of Mining and Technology) all have strong environmental programs. Indeed, you may want to consider one of these institutions for graduate research work.

All the information you need to achieve superior results in the Contest is contained within this handbook. If you carefully read this handbook and follow the advice of the more than 60 judges that contributed their experiences, you will obtain the maximum benefit from this educational experience. We wish you luck and look forward to meeting you in April!!!