

## Judging for the Vertical Flight Society Student Design Competition

### INTRODUCTION

In 1982, the American Helicopter Society (AHS) – now the Vertical Flight Society (VFS) – with the cooperation and support of several rotorcraft-manufacturing companies created the Student Design Competition (SDC) to promote student interest in a career in the vertical flight industry. The SDC provides an excellent opportunity for interested students, faculty and industry professionals to interact, and gives the students invaluable experience in a designing a vertical lift system to meet the needs and requirements of a request for proposal (RFP). The winning team in each category is sponsored to attend the Annual Forum and Technology Display, and present their design to a broad cross-section of the vertical flight community.

VFS and manufacturers wrote a formal operating plan that included a description of the competition, identified the organizations and individuals involved with it, specified the roles and responsibilities of all, and defined the rules. The Student Design Competition Steering Committee (SDCSC) maintains this plan under authority of the VFS Technical Director and the Technical Council.

The sponsors' responsibilities include identifying a point of contact, drafting the RFP, providing the monies for prizes and travel expenses, and coordinating the judging of the entries with the Chair of the SDCSC. The role of the Society is as a conduit or interface between the Student Design Competition Steering committee, student competitors and the sponsors of the RFP for a given year.

Since its inception, the competition and the rules and guidance for judging have evolved. The purpose of this paper is to describe some of those standards. The target audience is the judges and the students.

### STATE OF THE JUDGING ART

#### *Selection of Judges*

The Point of Contact (POC) for the sponsor and the SDCSC Chair has the responsibility to assemble a panel of judges. No formal list of qualifications exists, but a list of attributes has evolved over the years:

1. The judges must be fair, competent, impartial volunteers that come from industry and the government. They may have diverse points of view, but all have backgrounds in rotorcraft.
2. The judges must be experienced professionals and understand the problem presented in the RFP. They receive the same RFP, rules, criteria and answers to participant questions that the entrants receive.

3. The judges should possess broad general knowledge of the engineering problems associated with rotorcraft, which includes aerodynamics, dynamics, strength of materials and basic physics.
4. The judges should have expertise in some specific aspect of rotorcraft engineering.
5. The judges should be able to apply attention to detail, so that they can compare fairly and competently a proposal to an RFP.
6. The large picture and purpose of the SDC is to act as a teaching and interaction tool between students and industry professionals. The judges should keep this in mind.
7. The judges work voluntarily, without compensation or recognition from either their employers or the Society. They should have the time and willingness to devote many hours to reading and scoring several detailed proposals.

The SDCSC expects the judges to act professionally, courteously, diligently and without undue bias. Judging is an interesting, but laborious and anonymous job. The judges must approach this task as a labor of love for the industry and recognize the potential good that comes from teaching.

Finally, the SDCSC Chair and sponsors will seek a cross reference of judges from different sources in an attempt to assure diversity of opinion and to invoke the strong law of large numbers. This maximizes the sense of the community of the judges and minimizes the effect of an outlier score.

### ***The Judging Process***

The RFP describes the contest and the requirements, specifying the vertical flight system to be designed (e.g., payload, range, etc.) and format for the proposal to be submitted (e.g., schedule, page count, and the basic rules.) The list below describes the four basic categories, judging suggestions, and default weighting factors. The competition sponsor, being the sole author of an RFP, has the authority to change the relative weights of the four categories if they feel it is merited for their project.

- A. Technical Content (40 points)
  - The design meets RFP requirements
  - The assumptions are clearly stated and logical
  - A thorough understanding of tools is evident
  - All major technical issues are considered
  - Appropriate trade studies are performed to direct/support the design process
  - Well balanced and appropriate substantiation of complete aircraft and subsystems
  - Technical drawings are clear, descriptive, and represent a realistic design
- B. Application & Feasibility (25 points)
  - Justify and substantiate the technology levels that are used or anticipated

- Direct appropriate emphasis and discussion to critical technological issues
  - Discuss how affordability considerations influenced the design process
  - Discuss how reliability and maintainability features influenced the design process
  - Discuss how manufacturing methods and materials were considered in the design process
  - Show an appreciation for the operation of the aircraft
- C. Originality (20 points)
- How innovative is the solution
  - How much does the solution demonstrate originality and show imagination
  - Vehicle/system aesthetics
- D. Organization & Presentation (15 points)
- A self-contained Executive Summary that contains all pertinent information and a compelling case as to why the proposal should win.
  - An introduction that clearly describes the major features of the proposed system
  - A well-organized proposal with all information presented in a readily accessible and in logical sequence
  - Complete citations of the state-of-the-art technologies relevant to the work
  - Professional quality and presentation
  - Proposal meets all format and content requirements

The SDCSC opines that evaluation outcomes are (or should be) influenced more by process and substantiation and less by particular design decisions, i.e., **the process and rationalization is more important than specific answers. Judges and Academia have different experience bases and may therefore arrive at different conclusions.**

VFS headquarters and SDCSC Chair organizes the distribution and collection of score sheets and instructs the judges on the method for documenting individual proposal scores. The judges receive the same information as the entrants, so, except for specific instruction from either the SDCSC Chair or the sponsor, the judges work out for themselves how they will score a proposal.

The contest allows time for the entrants to review the RFP and ask questions of the sponsor on requirements or rules that are not clear. The sponsor and/or the SDCSC will transmit answers to all competitors and the judges. It is important to note that the rules exhibit some flexibility from year to year. For instance, in recent years, some schools proposed teaming with others. The rules did not specifically prohibit teaming arrangements, but teaming would have violated the team size limit. The SDCSC, in real-time and in coordination with the VFS Technical Director and headquarters, determined that teaming was an interesting and potentially useful experience, and adjusted the rules to permit teaming with an attendant increase in team size.

### ***Scoring the Proposals***

The categories and weighting factors are the primary means of evaluating the proposals. After that, where specific guidance is not given, the judges rely on their own experience, wits and interpretation of the rules to score a proposal.

The judges put their scores into a score sheet that the SDCSC Chair/VFS headquarters provides. The current scoring sheet is an Excel™ spreadsheet that enables judges to easily record comments and scores, and calculates the numerical scores and other statistics.

The SDCSC Chair and sponsor selects the winning entries based on the average of the weighted scores from all the judges. When the level of participation allows, judges should score all (undergraduate and graduate) proposals, to ensure an informed perspective. If the volume of submittals is unmanageable, the SDCSC Chair and sponsor will parse the review responsibility among the available judges, with a very strong preference that each judge review every submittal in the category for which they are responsible.

*The Vertical Flight Society and the Student Design Competition Committee reserves the right to decline to make all of the awards in all categories if there are not a sufficient number of submissions that meet the expectations of the judges. Proposals that do not, in the assessment of the judges, demonstrate an adequate understanding of the problem may be deemed ineligible for an award. In addition, any proposal that includes plagiarism or that copies substantial portions of prior proposals or publications will be disqualified.*

The decision of the judges is final. The responsibility and authority for execution of the VFS SDC rests with the VFS headquarters and the SDC Steering Committee. Any issues or concerns should be addressed to the SDC Steering Committee Chair, the VFS Deputy Director for Vehicle Design, and if necessary the VFS Technical Director.

#### ***Providing Feedback – Comments***

The SDCSC recognizes that the participants dedicate a significant part of their free time and school time to writing the proposals, in some cases receiving credit hours toward their degrees. With so much time and effort invested, the students deserve more feedback than an announcement of the winner in a press release from the Society. Therefore, the SDCSC recommends that judges record comments to provide feedback to the participants.

1. Personal notes that the judges used as memory joggers for scoring should be kept separate from the comments meant for constructive feedback. Only those comments meant to be constructive feedback will be delivered.
2. The constructive comments should be limited in volume, say two, though if the judge wants to provide more, he/she may. This reduces the burden on the judges but still provides feedback to the participants. Comments should address key achievements, pressing issues, or the most glaring omissions of the proposal.
3. The SDCSC Chair and sponsor will review the comments for appropriateness. If a comment seems inappropriate, the sponsor will delete or request a rewrite.
4. The judges should direct their comments only toward the authors of a particular proposal; they should not write comments comparing one proposal to another.

5. All submitted proposals are retained by the VFS headquarters and all winning executive summaries (undergraduate and graduate) are posted to the SDC public website.
6. If competitors requests feedback on their submission, VFS will provide the constructive comments to the designated point of contact for that proposal only. Neither the judges nor VFS will share comments with any other person or organization, nor will they provide any further feedback or explanation of the comments. The competitors may share their proposals and comments without restriction after the contest ends.

### SOME HELPFUL TIPS

The over-arching industry view of participation in the SDC is this: “Participation is gold, winning is gold plating.” Employers value a student’s participation in the competition, as it represents a valuable experience. The winning is not as important as the participation. **That is what is important to industry and the SDCSC wants the students to know that.**

Students will spend considerable time investigating designs, exploring alternative solutions, etc. Once the design work is finished, they will write a proposal that demonstrates their knowledge of the subject and technology, and their innovations. How well their proposal meets or exceeds the requirements of the RFP is the main focus of the judges. The inevitable mistakes, omissions, errors, and the like are not as important, though the final proposal should reflect a best effort, a desire for perfection. The SDCSC cannot and will not suggest a best path for student innovation, which is the whole point of this competition and how points are gained in the scoring. However, the SDCSC can offer the following tips to minimize penalties. These are not hard and fast rules, and in general, the sponsor is responsible for establishing the ground rules regarding scoring.

1. The students should avoid regurgitation of textbook formulae. By definition, the judges have backgrounds in rotorcraft engineering and are familiar with the basic concepts. Explaining  $F=ma$  simply uses up valuable page count real estate that could be devoted to developing further an important selling point in the proposal.
2. The sponsor has the responsibility to ensure that the RFP is not ambiguous. If anything in the RFP is unclear, the participants should request a clarification from the sponsor according to the process and timeline described in the RFP, through which all questions will be answered and distributed to all participants. However, if a competitor has a problem after the question and answer period has lapsed, the Society and the sponsor will refrain from providing any input on the competition details, leaving the participants to use their own best judgment. Raising issues and concerns with the SDCSC and the Society about the execution of the SDC is appropriate at any time.
3. Regarding a “violation” of RFP rules and requirements, it is the feeling of the SDCSC that the goal of the SDC is to encourage student interest and knowledge, not to declare a “best” solution to a typically very complex technical-business problem. The sponsor is responsible for clearly stating the penalties in the RFP (tip 2).
4. Administrative violations will likely receive firm penalties. For example, a formula such as  $\frac{1}{2}$  point per page over the limit or 2 points penalty for every person over the team

size limit, or five points for a missing element such as the executive summary. These penalties should be applied after all content judging has taken place. (These formulae are not the recommendation of the SDCSC, they are merely illustrative. Each year's sponsor will inform the judges of their preferred approach.)

5. Technical Content violations are open for trade-offs if discussed or rationalized. For instance, if a team violates a requirement with no explanation, a judge may presumably reduce the Technical Content score, but if a team provides a good, user-based rationale, e.g., this violation makes the product more affordable because of A and B, then the judge may penalize lightly or perhaps even reward the violation in the Originality category. Of course, some requirements are non-negotiable physical realities or a sponsor's hard and fast requirement that are clearly stated in the RFP. In that case, the judges should penalize accordingly, perhaps using a sponsor-supplied formula that is uniformly applied to all teams.
6. Each judge may choose his/her own method to award or subtract points in each category. Judging is subjective and some variation in scores is expected.
7. It is likely that some judges are graduates of schools that are participating in the competition. This is not considered an issue that requires any professional individual to recuse him or herself from judging the competition. The SDCSC has found that judges usually err on the side of caution when it comes to the perception of bias in favor of an alma mater. In any event, VFS is free to investigate allegations of institutional bias if evidence warrants such an investigation.
8. Teaming among universities is a recent development, and is generally well received by the participants, sponsors, judges and the SDC. It is the sponsor's duty to ensure that the legal size of a team is clearly stated in the RFP.

## **SUMMARY**

It is the hope of the Student Design Competition Steering Committee that this paper addresses some concerns, offers useful suggestions, and assuages some fears. This paper is a living document and will evolve with time and experience. To the students, the SDCSC extends its best wishes for an enlightening and challenging experience. To the judges, the SDCSC feels certain you will be impressed by the inventiveness and effort of our next generation of rotorcraft specialists.