the American Society of Safety Engineers
vol. 1, num 2
Fall 2004
THE JOURNAL OF SH&E RESEARCH

Safety Faculty Support for Student Contest Projects

*Jerry Davis, PhD, CPE, CSP
Research Assistant Professor

Shaman Ahuja
Graduate Student

***Department of Industrial and Systems Engineering**
309 Dunstan Hall
Auburn University, AL 36849-5346
(w) 334 844 1411, (f) 334 844 1381
davisga@auburn.edu

Abstract

Many colleges encourage their students to participate in contests where they are required to design, fabricate, test, and operate some type of device or system to compete against similar teams from other universities. Some of these projects are fairly straightforward, but others involve significant faculty and staff support. All have three things in common: students as the primary participants, faculty member(s) who provide technical and supervisory support, and some element of risk to those involved. This paper discusses some of the challenges and opportunities that safety faculty members might encounter as they assist these teams.

Key Words: Student & Safety, Contests, Projects or Competitions

Introduction

University/college/department sanctioned participation of students in design contests appears to be on the rise. Indeed, there are ample opportunities for students to participate in contests covering a wide array of curriculum areas. Most of these tend to be engineering oriented to some extent. In this article, we will discuss projects associated with the Samuel Ginn College of Engineering, located within Auburn University, Alabama. The college is comprised of nine departments: Aerospace, Biosystems, Chemical, Civil, Computer Science and Software, Electrical and Computer, Industrial and Systems, Mechanical, and Textile. Initially established in 1872, the College has an undergraduate and graduate enrollment of approximately 3,700 students, and 130 faculty members.

Traditionally, a recognized strength of the Auburn engineering experience is the ‘hands on’ approach that permeates the curriculum. Many courses include a project, and senior design is a required component of the curriculum. Some students are actively involved in research opportunities, and a great number of them participate in one or more of these sponsored design contests. Some recent examples of the competitions to which Auburn University has sent teams, with the lead department, includes:

- Chemical Car (Chemical)
- Concrete Canoe (Civil)
- Steel Bridge (Civil)
- 2002 Solar House Decathlon (College’s of Engineering & Architecture)
- Mini Baja SAE Vehicle (Mechanical)
- Balsa Bridge, glue less (Civil)
- Formula SAE Car (Mechanical)
- Solar Car (Mechanical)

Further contests anticipated or planned for 2004 include: Super Mileage, 2004, Solar Bike Rayce USA, 2004, Formula Sun Grand Prix, 2004, SAE Clean Snowmobile Challenge, 2004, SAE Walking Robot Challenge, 2004, ASAE ¼ Scale Tractor Design Competition, 2004, and the ASAE Student Environmental Design Competition: Fountain Wars, 2004.

Though there is a great deal of variability between individual contests, most have similar structures in certain areas. Participation is solicited by a sponsoring organization, rules and contest criteria are published, a faculty member with expertise in a particular area will either volunteer or be assigned, a team will be developed (typically led by a motivated, matriculated student, guided by the faculty member responsible for the project), project planning will occur, and resources will be requested. The project will typically include a design phase, followed by fabrication (perhaps the construction of a prototype), testing, travel to (and from) the contest, participation, and finally project retirement. This cycle for a representative project would then repeat itself based on the periodicity of the contest, most being scheduled either annually or bi-annually.

Resources (financial, space, material, shop-time, travel, equipment, faculty and staff time) required for the projects are typically related to the complexity of the contest, as well as the duration of involvement, and vary considerably. It is not uncommon for a larger project to cost in the $250,000 to $1,000,000 range and require two or more years of commitment by most team members. Team size varies proportionally to the magnitude of the project and, to some extent, the resources available. Smaller contest teams might be comprised of as few as three students with a faculty or staff member guiding the effort. Larger contests, such as the Solar House Decathlon, require assembling a team of possibly seventy-five or more students, seven to ten faculty members, and the assistance of a large number of support staff.

Nature of the Hazards

Hazards that are encountered during the course of a particular project range from those easily recognized to others that quite possibly have never been experienced by the team members. The potential for serious injuries, or even fatalities, to occur is an ever-present reality. According to a *Houston Chronicle* report by Nissomov (2000) detailing the circumstances in the aftermath of the 1999 Bonfire where 12 students were killed and 27 others injured, Texas A&M University was found wanting in risk management. A panel convened to investigate the collapse examined eight other institutions and found, “they take a more proactive approach in trying to prevent accidents in high-risk student activities.” Nissimov goes on to say, “Other schools had formalized, clearly defined and written policies; A&M had ‘some safety-related policies’ that were not well enforced.” With regard to oversight and monitoring of the projects he wrote “Other schools exhibited aggressive involvement by faculty and staff in monitoring the potential dangerous activities, while A&M had peripheral or informal faculty involvement.”

Other regularly scheduled student competitions have also reported incidents. For example, solar car “raycing” is not without its share of accidents and injuries. The University of Toronto (Wahl 2002), University of Iowa, and a Swiss team competing in an international event have all experienced accidents that involved significant damage to the vehicle and minor injuries (broken leg and foot, lacerations to face and foot, and shock) during the not too distant past. Additionally, a number of other teams [University of Waterloo (“Midnight Sun”), University of Michigan (“Michigan solar car”), New Mexico Tech (Channon & Quist 2000)], and a student team from Germany competing in an international event (Follain 2001) reported their solar powered vehicles being damaged in accidents, with the driver sustaining no significant injury.

Most recently (August 12, 2004), a twenty-one year old University of Toronto mechanical engineering student, Andrew Frow, was killed when the solar car he was driving suddenly veered into oncoming traffic and stuck a minivan. The University of Toronto student team was participating in the Canadian Solar Tour at the time of the accident, which was cancelled shortly thereafter (London Free Press 2004).

Such risk needs to be aggressively identified, minimized, and managed during the entire lifecycle of the project.

Design

For the most part, sponsors of student competitions address safety issues via the rules/stipulations provided to the teams. Whether or not the sponsors are doing an adequate job of properly addressing and controlling project safety is an issue that is best left for future discussion. Regardless, most sponsors require a release of liability to be signed by every team member as a condition of participation in the contest. For most students, this might be the first time that the topic of safety arises during the course of a project. It benefits all involved if safety can be demonstrated to be an active component during this phase of the project. Hirtz & Murray (1999) document how they required a solar car project team to use failure mode and effect analysis (FMEA) and human error analysis (HEA) as a safety tool during this phase. This proactive approach of eliminating or reducing the hazards in the design phase is to be commended. A less formal method is proposed by Higgitt & Bullard (1999), who discuss a five-step method for risk assessment suitable for student projects.

Fabrication

Virtually all of the larger projects require some type of metal fabrication involving both arc and conventional gas welding. Arc-welding cables conduct extremely large electrical currents. The compressed gas cylinders pose their own unique set of challenges. Most of the projects (particularly those such as building vehicles) require substantial cutting, bending, forming, shaping, and boring of the materials. Students routinely operate both large stationary machinery and smaller portable power tools. As such, shop safety and personal protective equipment (PPE) are both topics that should be addressed in detail during the fabrication phase of the project.

Assembly

Hazards associated with assembly are almost always directly related to the project. For projects related to vehicles there are the common concerns regarding material handling (strains & sprains, dropped objects), lacerations & abrasions, and tool usage for assembly. However, when constructing something as large as a solar house, this portion of the project clearly has its own unique hazards to address. Davis and Hayati (2003) discuss some specific hazards discovered and countermeasures introduced during the construction of a solar powered house. A particular hazard associated with this type of project involves students spending a large amount of time working in elevated environments (ladders, roofs, and scaffolds). The students are also exposed to the use of powered hoists, chain falls, and crane rigging, as they raise large wall and roof segments into position for fastening.

Testing

Depending on the project, this phase can be relatively benign or involve significant risk. Most of the risk comes with the testing and driving of the vehicles. It is simply human nature that students involved in the design and fabrication of these vehicles (Formula SAE, Mini-Baja SAE, Solar Car), want to drive them to see how their creation actually performs. Obviously, a significant amount of risk accompanies this phase, and therefore procedures should be planned out well in advance, rather than exposing participants to the risk of potential incidents due to “getting caught up in the moment.”

Transportation (Team and Contest Projects)

The logistical part of the contest requires the movement of teams and constructed projects from the university or college to the contest site(s) and back, and is one that cannot be trivialized. In fact, for some projects, it can actually be the most hazardous. Take for example the last solar car rayce, the American

Solar Challenge 2003. From July 13th to 23rd, 2003, 2300 miles of solar raycing challenged teams from around the world. High tech and high efficiency solar cars crossed the Great Plains, climbed the Rocky Mountains, and dashed over the Great American Desert to the finish line in Southern California. Logistically, the Auburn University team comprised four vehicles and trailers, six faculty and staff, twenty students, and the solar car itself. The team not only completed the rayce, but also drove an additional 900 miles from Auburn (Alabama) to Chicago for the start of the rayce, and then 2200 miles home from Southern California.

In a recent article titled "Bad Things Happen To Good Professors and Deans", Ann Franke (2003) states that of the 230 higher education employee fatalities reported by the Bureau of Labor and Statistics (BLS) from 1992-2001, 112 of the 230 (approximately 49%) were transportation related. Couple this statistic with the recent rash of occupationally related roadside fatalities and injuries (OSHA 2004), and this suggests that many of the raycing contests could very well be much riskier than they appear to be.

Available Safety Expertise

Universities that have safety engineering or safety management programs on their campuses and participate in these types of student contests appear to have a distinct advantage over those that do not have faculty that actively teach and research in the safety sciences discipline. Faculty members who lead project teams for these contests do so for the reward they experience by working closely with these students toward a common goal. Rarely is it the case that they gain financially or professionally from the time and effort they dedicate to a project; rather, it is quite often the reverse. Faculty incur additional long hours, meetings, research, supervision, fiscal (budgeting) tasks, and travel to support the students participating in these contests. Though faculty members that lead these project teams have a great deal of expertise in their discipline, they rarely have any formal training, education or experience, in hazard identification, elimination, reduction, and control. Consequently, they often turn to on-campus safety resources, where available, for assistance.

Obviously, no university or college wants to see any harm come to any team member participating in these types of contests. Though safety may be addressed in the contest instructions and requirements (some much more comprehensively than others) it is incumbent upon the college to address risk management and mitigation issues as part of the process permitting teams to participate in such events (Nissomov 2000, Higgitt & Bullard 1999, Davis & Hayati 2003, Franke 2003).

Safety Faculty Effort

The amount of effort that a faculty member expends on project safety support varies greatly depending on the contest and its associated hazards. The Dean of Engineering at Auburn University places the highest value on project safety involving students, staff, and faculty and has directed that all projects include a safety component and appropriate budget to support the safety effort. The mechanism to ensure that this happens continues to evolve, but most of the major projects have been addressed or are being addressed. It is important to note that safety should be an integral component of the project from the initial conception and planning stages. If this is the case, then what might be expected of the safety faculty member could include:

- Initial meeting with lead project faculty member to discuss specifics of the project, history of project participation, research to reveal any past injuries or near misses, level of commitment required, and the nature of the hazards associated with the contest.
- Work with the team to identify hazards during the design, fabrication, testing, travel, contest, and retirement phases of the project lifecycle.

- Contact the contest sponsors for interpretation and clarification of the safety rules.
- Attend team meetings (weekly, bi-weekly, or monthly).
- Perform hazard identification, analysis, elimination, or reduction.
- Develop and deliver (if required) safety training for identified hazards.
- Perform Personal Protective Equipment (PPE) evaluation for remaining hazards.
- Provide recommendations on PPE acquisition.
- Perform routine workplace (shop) inspections to ensure safe working conditions.
- Hazmat and MSDS support.
- Arrange for CPR and First-aid training (if required).
- Travel with the team to the contest site (if required).
- Participation in the On-site project, as necessary.
- Provide after action report to the lead faculty member and the Dean.
- Store remaining PPE and safety equipment for use in future contest projects.

Taken comprehensively, these requirements can constitute a significant undertaking. When one factors in the consideration that at any one time there may be three or more of these student projects running simultaneously, and add to that the normal faculty expectations for high caliber teaching, research, publication, outreach, and extension, there is a real possibility of becoming overwhelmed. For a safety faculty member to successfully function under these requirements, a substantial amount of support is required from their colleagues, department chair, and dean. If the workload supporting the student projects becomes excessive, some change in assignment might be appropriate (percent effort dedicated).

Other Potential Resources

Whether you are located in an academic setting that has a safety faculty member(s) or not, there are other potential resources to assist you in dealing with safety issues related to student projects.

Graduate Students

The ability to find interested, technically sound, graduate students who are willing to work with the safety advisor on one of these projects, is truly a godsend. This author has had the fortune of being able to directly work with a number of outstanding graduate industrial and systems engineering students on various student projects throughout the campus. These students are matriculating in a NIOSH supported occupational safety and ergonomics concentration, within the industrial and systems engineering curriculum. Each of the four (4) current active projects has a graduate student who oversees the routine aspects of safety for their specific project. During the 2005 racing season, the Formula SAE and 2005 Men's SAE Mini-Baja projects are supported by two doctoral students, while the Solar Car and Ladies SAE Mini-Baja are supported by masters' students. Allowing these graduate students to manage the day-to-day safety issues of the project, frees up the faculty member to act in an oversight role and provide guidance to each, as issues arise. Additionally, these graduate students receive valuable first hand experience, dealing with a diverse cross-section of associated safety issues.

Campus Safety Office

All campuses have a centralized safety office and staff that address safety, industrial hygiene, and hazardous materials management, among other issues, on a daily basis. Though usually separated from the academic portion of the university, they nonetheless can be a resource for help and guidance. The author's personal interactions with such professionals on past projects resulted in support for hazardous materials storage, hazardous materials disposal, MSDS assistance, and the provision of fire extinguisher training courses for team members. Every time they have been asked to support a student project they have responded in a prompt, friendly and professional manner and their support is much appreciated.

Occupational Safety and Health Administration (OSHA)
The OSHA web site (OSHA) contains a wide array of health and safety information for project safety. Potential resources include training materials, hazard recognition checklists, eTools, and the expert advisor series. Another resource is the directory of OSHA Consultation Service Partners (OSHA CSP) located in each state.

Conclusions

Including a safety faculty member as an integral part of any student contest project team is a distinct advantage. Providing safety support to student teams is a valuable contribution that any safety faculty member could make to satisfy a service obligation. Additionally, safety faculty members who actively participate in these types of endeavors will enjoy great personal satisfaction in helping the students to achieve their goal in a safe manner. Additional benefits for the students are provided via the safety education (Higgitt & Bullard 1999, Davis & Hayati 2003) they receive (both formal and informal) during the course of the project. Interested faculty members should inquire in the College of Engineering (Technology) as to the status of teams entering these competitions. Another potential source for this information would be student organizations. After determining that there is a project (or projects) you are interested in supporting, contact the faculty/staff member who oversees that project to discuss your potential contributions. A word of caution; it is much better to approach the project from a perspective of how your participation can enhance existing safety efforts, rather than to approach it from the perspective that safety might be virtually non-existent on the project.

However, safety faculty members will need to pay close attention to the time commitments required for project participation and modify their other responsibilities accordingly. For the long-term well being of the safety faculty member engaged in these activities, it is imperative that their colleagues, department chair, and dean wholeheartedly support their commitment in providing safety services to student contest projects.

References

ASAE ¼ Scale Tractor Design Competition. [online document]. 2004. Accessed October, 2004. Available at http://www.asae.org/students/tractor/asaecomp.html.

ASAE Student Environmental Design Competition: Fountain Wars. [online document]. 2004. Accessed October, 2004. Available at http://biosystems.okstate.edu/Gunlogson/Fountains2004.htm.

Channon, M. & Quist, D. We're making progress on our 2001 car. [online document]. 2000. Accessed October, 2004. Available at http://www.nmt.edu/~solar/.

Davis, G.A. & Hayati, F. (2003). Building A Solar House: An Exercise in Safety Education and Experience. *Professional Safety*, 48(5), 24 - 28.

Follain, M. Mad Dog in Australia—World Solar Challenge Diary. [online document]. 2001. Accessed October, 2004. Available at http://www.lsbu.ac.uk/solarcar/wscdiary.htm.

Formula Sun Grand Prix. [online document]. 2004. Accessed October, 2004. Available at http://www.formulasun.org/fsgp/event/fsgp2004/tech/regsdraft031106.pdf.

Franke, A. (2003). Bad Things Happen to Good Professors and Deans. *Change*, May/June, 23 - 29.

Higgitt, D. & Bullard, J. (1999). Assessing Fieldwork Risk for Undergraduate Projects. *Journal of Geography in Higher Education*, 23(3), 441 - 449.

Hirtz, P.D. & Murray, S.L. (1999). Teaching Safety Engineering Through Solar Car Racing. *Professional Safety*, 44(10), 30 - 33.

London Free Press: News Section – Death Cancels Solar Car Tour. [online document]. 2004. Accessed October, 2004. Available at http://www.canoe.ca/NewsStand/LondonFreePress/News/2004/08/14/581970.html.

Michigan solar car charges ahead. [online document]. (2003). Accessed October, 2004. Available at http://www.engin.umich.edu/news/archives/SolarCarUpdate/.

Nissomov, R. A&M found wanting in risk management. Houston Chronicle, 2 May, 2000.

Occupational Safety and Health Administration (OSHA). [website]. (2004). Accessed October, 2004. Available at http://www.osha.gov/.

OSHA Consultation Service Partners. [online document]. (2004). Accessed October, 2004. Available at http://www.osha.gov/dcsp/smallbusiness/consult_directory.html.

SAE Clean Snowmobile Challenge. [online document]. (2004). Accessed October, 2004. Available at http://www.sae.org/students/cscrules.pdf.

SAE Walking Robot Challenge. [online document]. (2004). Accessed October, 2004. Available at http://www.sae.org/students/walkrule.pdf.

Solar Bike Rayce USA. [online document]. (2004). Accessed October, 2004. Available at http://www.solarbike.org/event/sbr2004/tech/sbr04regs031105.pdf.

Solar Decathlon 2005. [online document]. (2004). Accessed October, 2004. Available at http://www.eere.energy.gov/solar_decathlon/.

Super Mileage. [online document]. (2004). Accessed October, 2004. Available at http://www.sae.org/students/superrules.pdf.

University of Waterloo. Midnight Sun. [online document]. Accessed October, 2004. Available at http://midsun.uwaterloo.ca/www/about/history.

Wahl, N. (2002). Solar race car damaged in accident. [online document]. Accessed October, 2004. Available at http://www.newsandevents.utoronto.ca/bin3/020822a.asp.

Jerry Davis, PhD, CPE, CSP is a research assistant professor in the department of Industrial and Systems Engineering at Auburn University, and a professional member of ASSE. He specializes in the areas of work measurement and occupational safety. He received his Ph.D. in Industrial and Systems Engineering (2001) from Auburn University. His teaching responsibilities include safety-engineering courses in both the undergraduate and graduate curriculum. Jerry is a retired United States Naval Officer, having served over twenty years in the nuclear submarine fleet.

Shaman Ahuja is a graduate student in Industrial and Systems Engineering at Auburn University, AL, specializing in Occupational Safety & Ergonomics. He is working as the safety manager for the Auburn University 2005 Solar Car team. Shaman is an ASSE student member since 2004.