

# CYBER JUNKYARD TACKLES THE ENERGY CRISIS

In South Africa we experience the global energy crisis through regular load-shedding by Eskom and the resultant power outages. With carbon emissions spiraling out of control, our global thermostat rising and the polar ice-caps melting away, nations are at last galvanizing towards greater energy efficiency.

With this in mind, the 2007 Siemens Cyber JunkYard (CJY) Challenge could not have been more relevant. The aim: to construct and control an efficient yet simplistic pilot plant demonstrating energy efficient process automation in a simple fluid pumping application with the added objective to address what is clearly lacking in engineering in South Africa – bridging academic theory with practical industry requirements.

Siemens project manager for CJY 2007 Devendree Karuppanan says, "This year we also wanted to build on CJY's position as a prestigious competition where only the best institutions compete. To achieve this we had a 'tender to enter' concept that allowed us to mimic industry practices and select universities that were truly worthy of participation. This raised the stakes, and the standards."

In the past, CJY projects were based on manufacturing processes such as rapid key ring manufacture or building a bottling plant, but this year the concept focused more on process design, model scale building, fluid dynamics, demand side management, return on investment and life-time running costs.

Siemens simplified the mechanics of the 2007 projects while the hardware was bigger and bulkier which presented a tougher challenge than last year. In addition, Siemens brought in Simocode which provides for direct on-line control of the motors and requires the Profibus master PLC in the system.

Profibus is a far more powerful PLC than students are usually acquainted with and requires more powerful computers to run the more intricate and detailed programming software for the S7300-based PLCs (known as Step 7).

Siemens and Festo supplied equipment worth over R200 000 per university and strict specifications and guidelines were given eight months before the finals.

Dimensional constraints and concise specifications for the me-

chanical design were stipulated together with high performance capabilities, ergonomics and the operational safety of the pilot plant.

Commenting on this year's standards, chief adjudicator Dr Roy Marcus of the Da Vinci Institute says, "Overall standards were higher this year. Most projects (10 out of 13) were fully functional but my big concern is the link between real industrial situations and the academic world. This year we tried to impress the hard-core business reality of the engineering environment on the students and by and large, teams seemed to have missed that. The big question is the kind of guidance students are receiving in terms of relating theory to practice."

A milestone achievement in 2007 is that most projects will be useful for teaching purposes in future. Feedback from the lecturers is that this year's projects are more likely to remain intact and not be cannibalised for other projects in future. At least one institution has even started formulating syllabi using this year's equipment. Post-grad students will also be able to do additional research on these rigs which can be used for fundamental training on pressure, flow and motor concepts."

From a hardware construction point of view, most projects were of outstanding quality but understanding the total complexity of the energy efficiency brief proved difficult. The winning teams clearly grasped the fundamentals.

A number of teams demonstrated innovation but teams that did not meet the specifications were heavily penalised. Dr Marcus confirms, "You simply cannot deviate from the specs or you will lose your customers. This has to be ingrained into the mindset of our students."

The panel of judges was made up of six judges from Siemens, Festo and the Da Vinci Institute. Approximately 15% of marks were awarded on the basis of compliance with the mandatory configurations, 25% for innovation while return on new investment, startup costs vs life-time running costs, actual understanding of the project and demonstrating energy efficiency made up the rest of the judging criteria.

The model for determining efficiency from a cost point of view presented difficulties and it's clear that universities across South Africa

must start injecting some sort of business prowess into their students. Dr Marcus says, "This was the toughest judging process I've ever been involved in because there were concerns about the final numbers in terms of efficiencies. Most teams demonstrated they could design and build a working rig. But the key element was demonstrating whether they had adequately considered efficiency."

Adjudicator and initiator on the Cyber Junkyard Challenge, Craig Hudson from Industrial Networking and Control Systems added that a number of teams did not address how they would apply their models in industry, "They confronted the technical aspects of the motor efficiency rather than the entire system's efficiency. Siemens and Festo supplied highly advanced equipment and what needed to be done was to effectively implement an already efficient motor on the pumping system."

### Neck and neck

For the first time in the history of the competition, judges were unable to decide on a clear winner and the Nelson Mandela Metropolitan University (NMMU) and the University of Johannesburg (UJ) tied for first place and each walked away with a cheque for R100 000. The Central University of Technology (CUT), Free State came in third.

The NMMU team - Khangelani Samela, Arnold Mzondi, Devin Damons, Chuma Mayatula and Azola Mhlauli – emerged as joint winners not only for closely adhering to the specifications but for really addressing energy efficiency. Their rig demonstrated that for the same system flow rate when the machine was configured with a direct on-line starter and the flow rate controlled by throttling valves, more energy was consumed as compared to the machine configured with a Variable Speed Drive (VSD) and the flow rate controlled by changing the motor speed. The best efficiency was achieved when the machine was operated with the VSD in combination with a high efficiency motor with the pump head at a minimum and the motor load at 75% of the rated motor power.

Team dynamics also gave NMMU an edge. Project leader Chuma Mayatula says, "We really learned to work as a team, to respect the suggestions of other members and to deal with constructive criticism. Working with unfamiliar equipment and learning budget planning and time management has been invaluable to all of us."

The UJ team - Pragasan Kisten, Mahenderen Pillay, William J Ngoma, Bilal Moolla, Pradesh Mewalala, Sinazo Z Mazwi and Hano Lock - also demonstrated that using a Siemens high efficiency motor in conjunction with the Siemens Micromaster VSD consumed significantly less electricity. Monitoring and controlling was clearly demonstrated with the Siemens C7 Human Machine Interface (HMI).

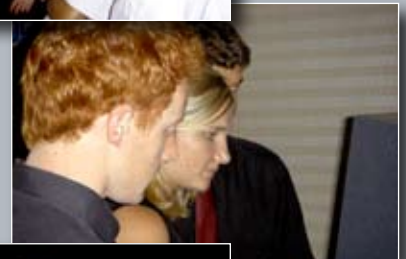
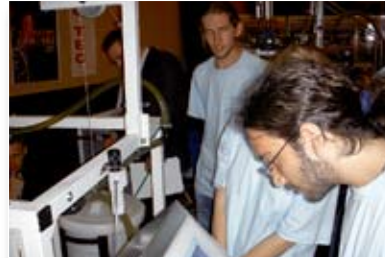
Monitoring and controlling comprised of flow rates (l/min), electricity consumed (kW/h), tank position (%), selection of motors and control method (soft starter or VSD). Also included was the Supervisory Control And Data Acquisition (SCADA) graphic design of the pump configuration.

A number of teams took these aspects into consideration, but UJ also paid special attention to safety by incorporating interlocks, demonstrating professional wiring as well as high labeling and documentation standards and good engineering practice with regards to Step 7 software programming.

Bilal Moolla, Siemens field service engineer and CJY mentor provided technical support to 5 universities including UJ and CUT, commented, "The big learning curve came in terms of how much research and development was required. The team (all part-time electrical engineers) was also enlightened as to the need for a multi-disciplinary approach to engineering."

Third placed CUT, Free State is sure to be back next year. Vernon Viljoen, David Olyn, Lyle Smith, Thabo Bihi, Bertus van As and Dr Herman Vermaak came to similar conclusions – regarding energy efficiency – as the winning teams. They also adhered to the strict specifications.

Their design ensured their rig could be modular, thus allowing for future development and practical experience for both electrical and mechanical





engineering students. The rig's weight was dramatically reduced by using aluminium and included perspex covers for the frame to protect viewers from moving parts. The rig incorporated a false bottom so the team could easily gain access for wiring the units. A slash plate was placed in the reservoir to reduce turbulence enabling more accurate level measurement.

All the team members agreed that CJY was an eye opener for them in experiencing what industry itself is about. Dr Vermaak commented, "The team learned that in industry there are no problems, only solutions and agreed they learned much more through CJY than in normal laboratory assignments."

### Viva Zimbabwe as SADC countries climb on board

This year five SADC countries from beyond SA's borders tendered for the finals - CJY has now truly fledged as a southern African competition. Three of these made it to the final 13 - Zimbabwe, Namibia and Zambia - and once again all demonstrated true commitment against mountainous odds, in particular the Zimbabwean team.

Craig Hudson praised the Zimbabwean's presentation on efficiency and energy saving as one of the best of all. The team arrived with practically nothing, had hardly any budget to purchase basic materials and worked throughout the night showing tremendous team spirit and tenacity. At the gala dinner they were deservedly handed a special award consisting a trophy and two weeks training at the Siemens Training Institute.

Dr Marcus comments, "Maybe the South African students should take a wake-up call from our neighbours to the north and realise how easy they have it in this country. These SADC students will have a big advantage one day, especially when it comes to doing business in Africa and when confronting the obstacles and curved balls that all engineers face."

### Looking ahead

An annual concern is how seriously universities and other tertiary institutions take the CJY challenge. While some are seriously committed to it, others simply use it for academic credits or rely on students to compete on a voluntary basis. Every year, Siemens and Festo provide significant incentives in terms of the equipment on offer, prizes and the real-life experience to be gained, but in many cases there is an obvious lack of support from the institutions themselves.

Dr Marcus believes we should be looking at the problem of bridging theory and practice on a national level and to encourage learning institutions to take CJY more seriously. "Our government is crying out for the private sector to help with the educational process and I think CJY is the best example of this in the country. We really need many more private institutions such as Siemens and Festo to link with universities, and for more universities to take up the opportunities offered by the private sector," said Dr Marcus.

With an eye on promoting the CJY concept further afield, Siemens is currently producing a formalised white paper illustrating the requirements in terms of logistics, training, equipment, project design, all based on the previous five years' experience. This has received support from both the Siemens parent company and Festo in Germany.

### In conclusion

CJY's foremost principles are to introduce students to topics relevant to industry, to tackle a particular industry problem and prepare them for the world beyond academia. This year was no exception.

Devendree Karuppunnan concludes, "For me the great success of CJY is that everyone who competed will have a distinct advantage when they finally enter industry." Previous years confirm this with a large proportion of finalists receiving formal employment with Siemens' systems integrators and companies further afield not long after graduating. Gary Wilson, who was involved in the running of CJY since its inception 5 years ago wraps it up, "A couple of years down the line, if you have CJY on your CV, you've got it made."