

INTELLIGENT STADIUM

A high level HMI system installed at Green Point Stadium will significantly enhance the operation of the facility. The first of its kind in South Africa, the system holds opportunities for duplication.

Green Point Stadium is doing justice to its name. Cape Town's multi-purpose built 2010 stadium is rapidly nearing completion and 'green' parameters are very much a part of the picture at the iconic 68 000-seater stadium.

Seven 'low-hanging fruits' or as the team coined them, 'must-have' interventions were identified to make Green Point the environmentally-friendly sports destination of choice. These include water sub-metering, energy sub-metering, off-set programmes, education and awareness campaigns, operational guidelines and targets and a national waste management programme. The seventh 'must-have' intervention comprises the optimisation of the stadium's sub-systems via a central remote building management system (BMS).

Essentially, Green Point's BMS has been 'optimised' to a point where all electronic functions and third-party services at the stadium are linked to a single interface aptly named a human machine interface (HMI) that sits logically above the BMS. Consulting engineers, WSP claims that this system is the first of its kind in South Africa to link all stadium services to a single-source point of control at such a high level. Naturally, the system is linked to the stadium's heating and cooling structure – another implementation that boasts energy-efficient systems with several operational spin-offs.

The benefits that the stadium's sophisticated BMS and HMI hold for the stadium operators and facilities managers who will run the facility are major.

Fully integrated HMI

The vision for Green Point was to build an intelligent stadium. Electrical engineer at WSP, Ian McWilliam details, "Our vision was to merge all sub-systems and technologies inside the stadium onto an IP platform, from which any system could be controlled remotely from a central point, namely the VOC. We felt an existing off-the-shelf HVAC VMS system would not give us the flexibility we were looking for to integrate all systems. We, therefore, opted to develop – from scratch – a system that would bring it all together."

As a result, an independent HMI has been developed – running separate from all of the other systems, yet combining these systems at a single point of control. "The BMS is used for state collection and control instruction, whereas the HMI sits on top of the BMS and is used to seamlessly integrate all of the systems," says McWilliam.

The first electronic service that is linked to the HMI is access control, which is split into four sections: mass access control (turnstiles), parking access control, general areas and back-of-house access and finally, access control to the hospitality suites.

The second electronic service linked to the HMI is CCTV – including all internal cameras and outside perimeter cameras. All CCTV footage is encoded at the camera and streamed over the structured cabling network to distributed network storage devices. Thirdly, fire detection and automatic voice alarm functions are linked to the system. The stadium is split into smoke zones illustrated on the HMI. When a fire signal is received by the fire alarm panel, the

On the brink of completion



Landmark rising



Green Point's BMS has been optimised to a point where all electronic functions and third-party services at the stadium are linked to a single interface

signal is sent to the HMI and graphically represented on the HMI screen. As the fire increases, so the graphical representation reflects the escalation of the evacuation procedure in the stadium until the entire stadium is in full evacuation mode.

Third-party services linked

The HMI takes the above-mentioned electronic services and displays them on a single graphics page, yet it also provides central operational control to all third-party services. These services include HVAC, plumbing and drainage, irrigation, fire protection (sprinklers), lighting control, lifts and the facility's electrical SCADA system. "We are intermitting an interface between these services and the HMI so that they are all displayed on the screen," McWilliam imparts.

Should the HMI fall over, however, these systems can operate independently. "Some of them have their own BMSs – we're just taking all their systems and feeding them into a higher level interface."

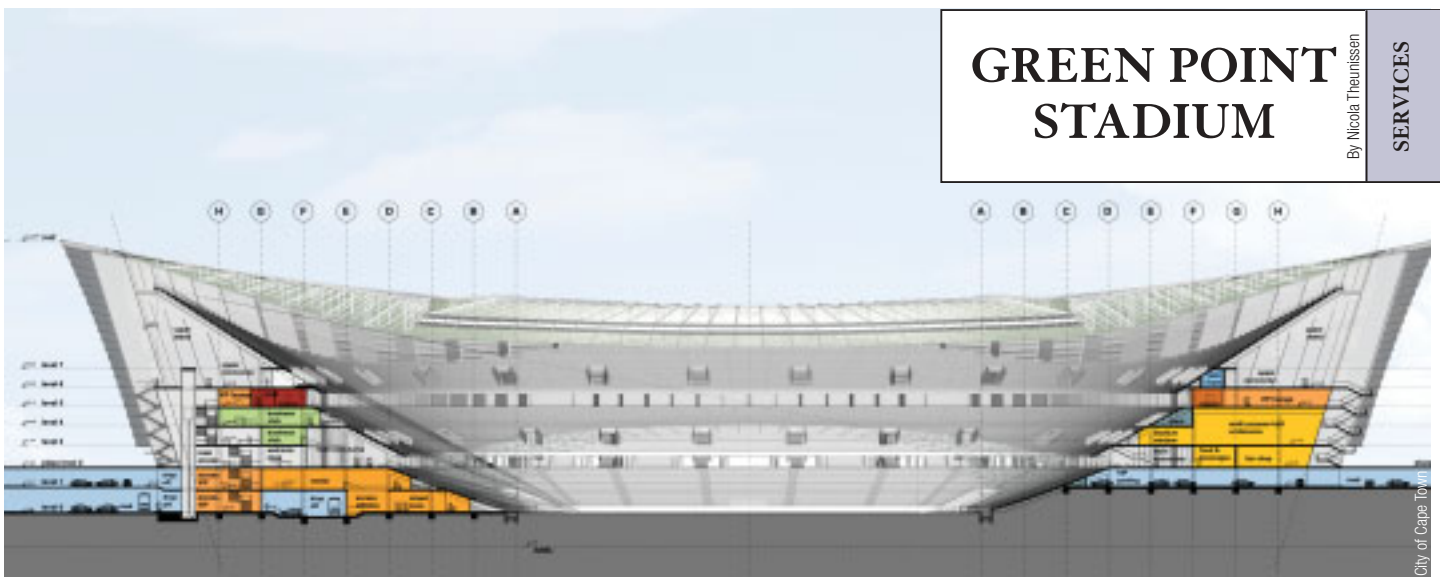


All services accessible through human machine interface

City of Cape Town

Facility fact box

- 68 000 seats
- 52 m high (15 floors in total)
- Field dimensions: 290 x 265 x 48 m
- 50 VIP suites
- Basement parking for 1 200 cars
- 12 lifts throughout stadium
- Four TV studios
- Medical centre and police station
- Accommodates 120 wheelchairs



GREEN POINT STADIUM

By Nicola Theunissen

SERVICES

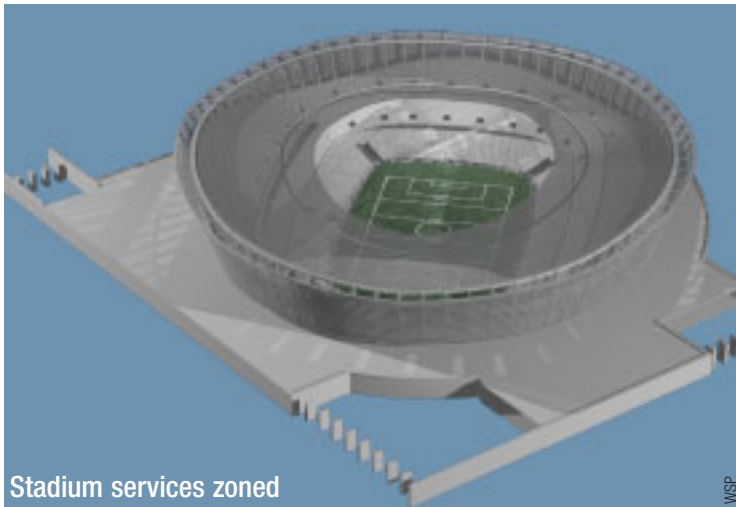
City of Cape Town

System provides central operational control over:

- Access control points
- CCTV
- Fire detection
- Automatic voice evacuation system
- Audio-visual installations
- Telephone and data networks
- As well as third party services such as:
- Lifts
- Fire protection (sprinklers)
- Lighting control
- Plumbing and drainage
- Irrigation
- HVAC
- Electrical SCADA system

Centre stage

The human machine interface (HMI) is a graphical interface which sits on top of the stadium's building management system (BMS), which captures all the data. It will be situated in the venue operations centre (VOC) on the north-western side of the stadium, and through a web-based system, it will seamlessly integrate all stadium services – providing the facilities managers with full control.



Stadium profiled

The consulting engineers implemented different profiles at the stadium to switch and adjust systems when needed. In essence, they are divided between an event profile and a non-event profile.

“If you have an event happening on a specific day, you know you need to start up your boilers, say, three hours before. If you go into an event profile, it will send a signal to all the systems prior to the event so that it activates your services at the right time. The services will be used according to the type of event. If you only have an event on the western stand, you certainly don’t want the ventilation and air-conditioning running on the other side. We provided that type of functionality to the operator,” tells McWilliam.

In addition, you don’t have to run all of the services on non-event days, which are – for most parts of the stadium’s life – six days of the week. This significantly reduces operational expenditure, for example water heating and electricity costs. Furthermore, the stadium has been zoned – typically each level will be split into four areas: north, east, south and west. “But, we can only provide this type of functionality for a service if it has the intelligence,” qualifies McWilliam. Lighting, for instance, has been zoned, but in bulk areas only, which means the HMI can only turn off the lights in bigger sections of the stadium and not individually.

Connection a challenge

A major challenge with the development of the system came with the integration of third-party services, tells McWilliam. “Because this has never been done before locally, the third-party consultants didn’t know precisely what type of information they needed to provide us with in order to build it into our system. So, we

Different profiles have been implemented at the stadium to switch and adjust services when needed. They have mainly been split between an event profile and a non-event profile. The stadium has also been split into four zones: north, south, east and west.

needed to guide them by giving them a points list.”

Although all of the services do not have BMSs, they all have controllers within them that recognise the status and monitoring. The challenge was to put that information into controllers that speak one language (non IP) and feed into the HMI (IP), says McWilliam.

He adds that the integration of services like lighting or plumbing and drainage is not unique and has been done before, but not to the extent of an all-inclusive scope of services at the particular level of the HMI at GPS. Consultants had to make contractors aware of the functionality the services would require, yet this had not been specified early in the game. At tender stage, very little of the required information to build the system was available to consultants and contractors. “We didn’t know, for instance, that the HVAC system would be a Daikin system; we just knew that we had to put a controller in place that had the functionality to speak a particular language that we did not know yet.” These factors all set challenges for its implementation.

Major VRV circuit installed

As far as heating and cooling is concerned, the stadium boasts another first of its kind in terms of size: a water-cooled variable refrigerant volume (VRV) cooling system. VRV systems are usually applied in much smaller applications, but the installation of the VRV system at Green Point will hold several operational benefits for the operator. According to William Aphane from Integrate Consulting



North zone



South zone



East zone



West zone

	CCTV	Access	Lights	Fire	HVAC
Level 0	•	•	•	•	•
Level 1	•	•	•	•	•
Level 2	•	•	•	•	•
Level 3	•	•	•	•	•
Level 4	•	•	•	•	•
Level 5	•	•	•	•	•

Engineers, the system will enable the operator to cool small zones efficiently or the entire stadium during large events. “It involves a central system with individual cooling units for spaces requiring cooling only at a given time,” he informs. There are a total of 134 fancoil units and 34 condensing units linked to the VRV.

Individual heating saves

Additional energy savings will be achieved by the installation of 9 kW in-line water immersion heaters as opposed to heat pumps. Each condensing unit will have its own individual in-line heater connected to it, tells Aphane. “By installing individual in-line heaters, we have eliminated the use of huge boilers or high capacity heat pumps. Each condensing unit operates individually with its specific in-line heater.” This approach gives a lot more flexibility in terms of independent heating and cooling – one system can operate in heating mode while the other system can operate in cooling mode simultaneously.

AC controls

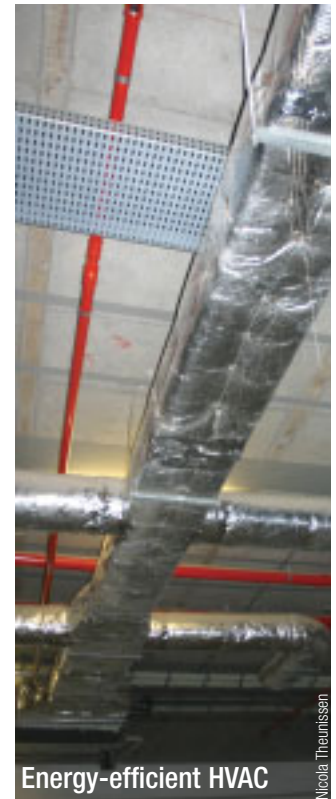
In terms of controls, Aphane says it was not too challenging to link the air-conditioning system to the HMI. The point list increased the practicability of linking the systems with each other, he says. The relatively simple Daikin control system has been installed to control the VRV system, whereas the condenser water system will have its own controls. “The Daikin Bacnet and the condenser water system will be inter-fused through the AC BMS master controller which will communicate

“We felt an existing off-the-shelf HVAC VMS system would not give us the flexibility we were looking for to integrate all systems”



Translucent roof facilitates natural light

GMP



Energy-efficient HVAC

Nicola Theunissen



Daikin controlled

Nicola Theunissen



Water-cooled VRV system provides flexibility

Nicola Theunissen

with the stadiums' HMI," he imparts.

Field controllers in the condensing unit plant room will be programmed to control the two-way, three-port condenser water motorised valves, the in-line heaters and in-line circulating pumps.

The motorised valves will be controlled by temperature sensors on the main supply and return condenser water pipes. When the water temperature in the system is within the operational range the motorised valves will close, thus re-circulating the water in the plant rooms. When the motorised valves are closed the central cooling towers and the main condenser water pumps do not need to run – thus resulting in significant energy savings.

Console units in offices

Fancoil units are installed in VIP boxes, media centres, offices,

change rooms and warm-up areas. "For general offices, we haven't installed fancoil units, however," says Aphane.

The offices on the third and fourth floors of the north and south stands of the stadium are air-conditioned by console units. If only a few offices are occupied, the occupants can switch on their own air-conditioning units.

In addition, the stadium has also incorporated passive design principles, such as day-lighting, natural ventilation, solar control and night-time cooling, to reduce the reliance on energy-hungry mechanical and electrical systems. The building is raked outward to shade itself, while the mesh fabric cladding allows only 30% light through and the white colour reduces thermal radiation. A translucent roof also facilitates natural lighting.

The water-cooled VRV system will enable the operator to cool small zones efficiently or the entire stadium during large events

Maintenance made easy

Although the system comprises an extensive amount of fancoil and condensing units, maintenance will be fairly easy, says Aphane. "We have two plant rooms: the northwest and southwest plant rooms, and in terms of operating and maintaining the individual units, we have installed shut-off valves on the take-offs of each unit, so we will be able to isolate a condensing unit from the rest of the system and do maintenance on it."

The two plant rooms are situated on level one of the stadium, whereas the cooling tower yard is outside the podium, 30 m away from the closest plant room. The system has a circulation rate of 118 l/s and will most likely be drained every six months, says Aphane. "The sub-contractor will do the maintenance and will provide a 12-month maintenance plan to the operator," he says.

How 'green' is your stadium?

To determine the level of environmental best practice at our 2010 stadiums, the previous Department of Environmental Affairs & Tourism (DEAT) through the Urban Environmental Programme commissioned a review of the 'greening' status of the FIFA World Cup stadia. The review aimed to determine how 'green' the stadium designs were and also to enhance environmental best practice within these facilities. Five FIFA stadiums participated in the review: Green Point Stadium, Moses Mabhida Stadium, Athlone Stadium, Royal Bafokeng Stadium and Peter Mokaba Stadium.

Brooke Patrick Publications – publisher of JFM Sports Facilities – compiled a booklet in collaboration with the DEAT on the 'greening' of Green Point. The booklet is a not-to-miss for facilities managers and stadium operators with an interest in the link between operational management and 'green' issues.

Stadium operator – full control

The HMI will be situated in the venue operations centre (VOC). The centre is split, with the main office body on level four of the stadium (with no view onto the pitch). The head of the VOC is on level five and provides a direct view onto the pitch.

All intelligence will be accumulated in that section and when the stadium operator goes to work every day to run the facility, his office will be located in the VOC. He will literally be able to sit in a room at his PC and interrogate all of the services within the stadium.

According to WSP's Richard Goldschmidt, the HMI is basically a 'brain' that tells the facilities manager everything about the building. "It detects fire signals and sends a ripple of instructions out; it monitors carbon monoxide levels in the parking bays; it can indicate which pipes are sending water to the showers, what the exact temperature of the water is". In essence: detailed control to the operator, whereas a normal BMS would only have covered components.

Universal transmission infrastructure

As far as transmission infrastructure is concerned, the consulting engineers went for a structured cabling backbone. A universal cabling system was used so that all voice, data and television signals run over a single 10 gig cabling backbone. The benefit of this is that you do not have different contractors installing different services, says McWilliam.

"We have also future proofed the communication network by installing a 10 gig network since we don't know what technology will be around in 10 or 20 years. It will ease the maintenance of the site significantly. One contractor was used to install all of the cables – therefore, you have one point of call if anything goes wrong."

Fewer skills required

Another design criterion for the system was to reduce the amount and level of skills required to operate the stadium. The skills level needed to analyse the HMI and accordingly,



Training and planning – a vital part of design

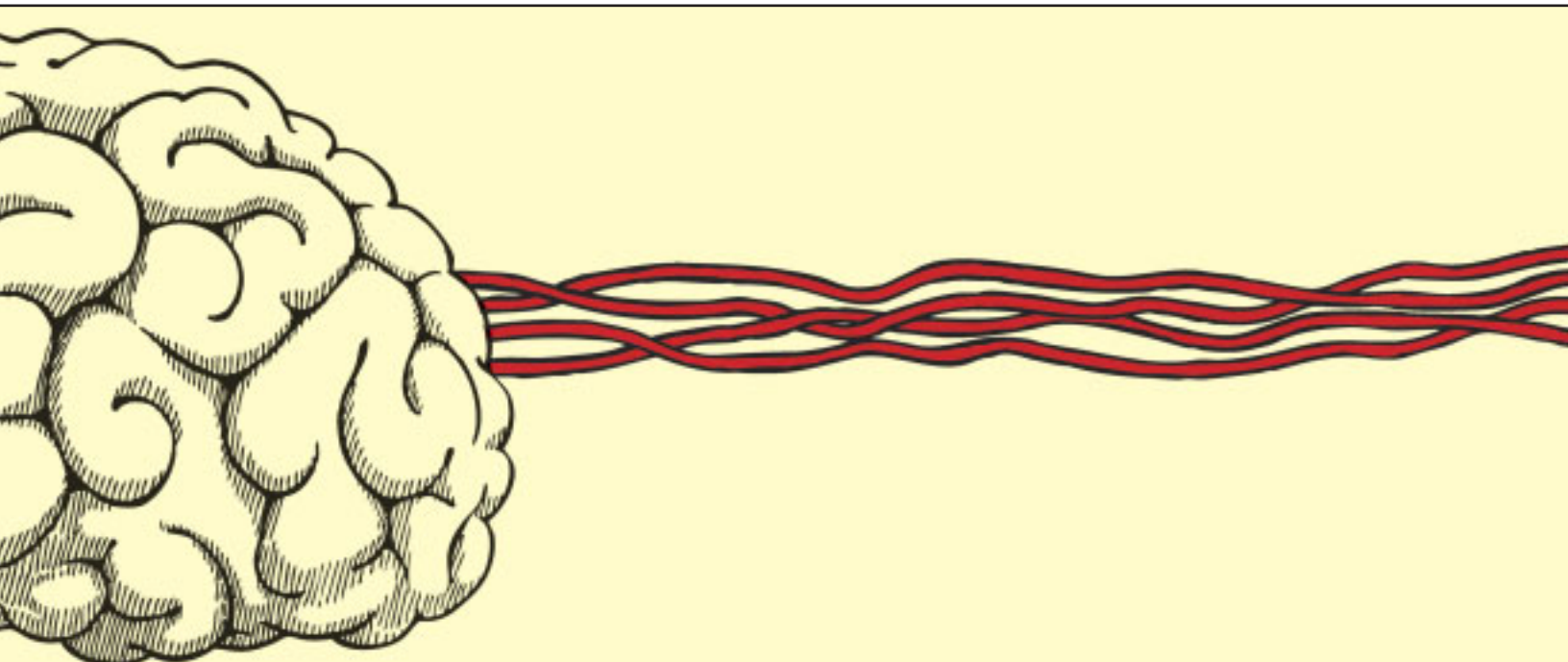
Gerald Garner

The HMI is basically a 'brain' that tells the facilities manager everything about the building

make high level management decisions – in case of the operator – is high, but for basic monitoring, you do not require a skilled person.

"If the HMI was not installed, each service within the stadium would have had to be monitored individually and you would have needed additional security guards on the ground, for example. Now, you need less people on the ground and less people to understand the premises," says McWilliam.

Additionally, the learning period to understand the maintenance scope of the stadium is reduced and





Innovative visitor centre creates excitement

instead of the operator needing to understand all of the systems, he only needs to understand one. The capital expenditure of the system is high (approximately R2-million), but because you need fewer people running individual systems, your operational expenditure will be lower.

Duplication viable

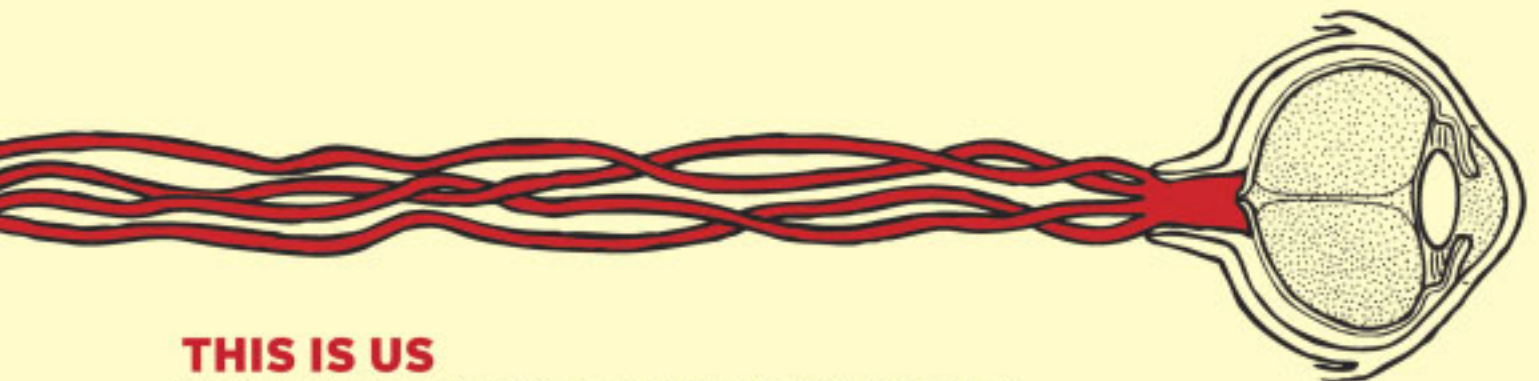
The system holds a lot of potential for duplication, says Goldschmidt. "What we have done is we have taken this system and basically copied it for the Nelson Mandela Stadium in Port Elizabeth (PE). The PE stadium runs on the same principles, with the same design team. It doesn't provide the full functionality, however. The electronic scope is slightly reduced and third-party services were not told upfront that they would need to consider the integration, so it is not an all-inclusive stadium."

Future duplication of the system will be easier as the consultants will be able to tell contractors upfront what type of data to provide in the future. Additionally, the system does not only hold the potential for duplication at stadiums. "It can work for any building," McWilliam enthuses. "Any high rise building with these services included has the opportunity to build those services into a central system for the operator. The HVAC controls might not be Daikin, for instance – it might be a different controller with a different protocol – but the principles will remain the same," he concludes. ■

The system holds a lot of potential for duplication



Stadium tours available



THIS IS US

The best monitoring equipment in the world is nothing without the highest quality fibre optics to connect them. We are at the forefront of locally designed and manufactured transmission equipment, linking up some of South Africa's most sophisticated CCTV networks.

Contact us 011 786 5575 or www.bfrdigital.co.za

BFR
DIGITAL