Business

Brains behind Eskom's operations

A small group of experts monitors operations and keeps the utility up to date on new developments

Sarah Wild

From the outside, Eskom's research, testing and development (RT&D) centre bears the tell-tale characteristics of archaic apartheid architecture: the heavy lumps of beige concrete that ignore their aesthetic impact on the surrounding yellow-grass landscape of City Deep.

But inside this building are innovative technologies that seek to pre-empt, fix and anticipate South Africa's electricity demands and Eskom's technological problems.

"This is something South Africans should be aware of — a pool of committed people, doing work. But naturally I'm biased," says Barry MacColl, the general manager of the unit.

With an operational expenditure budget of about R602-million and 380 employees, the unit is one of the country's larger research hubs. For some context, the Council for Scientific and Industrial Research (CSIR), which is the largest scientific research institute on the continent, has slightly fewer than 2 000 researchers and a budget of about R2.3-billion.

With a limited budget and comparatively small staff complement, although it represents 1% of the power utility's total staff, the research unit does not necessarily push the boundaries of science. But that's important when the power utility includes, among other things, 22 000km of transmission lines, extensive infrastructure and dozens of power stations.

"It's mainly applied research and problem-solving," MacColl says. This could be a power station with a turbine blade problem, or investigating which solar technologies could best be applied to a particular situation. Often we take something done elsewhere in the world and see if it can work for Eskom," he says.

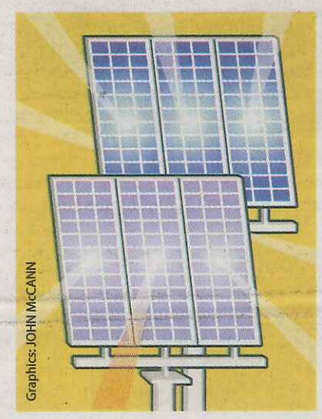
There are five distinct departments: plant performance and optimisation; technology strategy and research management; sustainability; power delivery and utilisation; and business enablement.

The aim of the unit, MacColl says, is to "provide credible scientific advice. We advise on science, not contracts."

This advice can range from how long a turbine can continue to run before maintenance, whether a coal shipment is of good enough quality to warrant its price and whether it can be used in a power station.

MacColl refuses to be drawn on coal contracts, which has been a source of contention. Eskom is claiming R2.1-billion from Optimum Coal Mines, which it says supplied the utility with suboptimal coal. "In my 10 years in this building, I have never been asked to do something amoral. The science must speak louder than other standards," he says.

This is why MacColl says that knowledge generation is only part of the job. "I, as general manager, do not make the decisions ... I have to convince my colleagues and back up my opinion with scientific knowledge."



Graphics: JOHN McCANN

Solar panels

There are so many different types of solar technologies that it is difficult for a parastatal, let alone an individual, to decide on what to choose. Giant metal frames and tiled solar panels occupy a yard in front of the RT&D building. This testing ground has been operational for about 18 months, says Kumaresan Cunden, a mechanical and renewable engineer of the parastatal.

It provides about 400kW to the building, while testing the different types of technology, MacColl says. Panels on A-frames stare at the sun, tracking it from east to west. Others are north-facing. There is also a combination of thin-film and polycrystalline panels. Thin-film comprises a layer of photovoltaic material that converts sunlight into electricity, and polycrystalline panels contain wafers of silicon crystals.

Asked which is better, Cunden responds: "Depends what you want." Thin-film is better if you have limited space, he says. Polycrystalline is more efficient at converting sunlight into electricity, but it becomes less efficient at high temperatures. The aim, MacColl says, is being able to advise which solar panel technology works best in a particular situation.

Eutectic freezing

Acid mine drainage has made it on to the front pages of newspapers and into parliamentary committees. One solution, which can also be applied to the liquid waste from power stations, is eutectic freezing. Different substances freeze and form crystals at different temperatures. This is the idea behind eutectic freezing. If the substances in a liquid waste stream all freeze at different temperatures, it's possible to isolate them.

"We can't just put the effluent discharge into the environment," says Eskom's Akashnie Raghu. "Water is scarce and we need to find technology to recover this [power-station polluted] water."

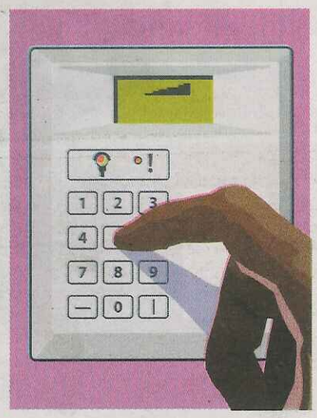
The eutectic freezing system at the RT&D centre can handle up to 100 litres an hour.

"The first of its size in the country," Raghu adds. The dirty water undergoes three different "campaigns", from ambient temperature to -2°C, from -2°C to -15°C and from -15°C to -23°C. At each stage, different crystals, or "solid salts", form.

"It's easier to handle waste as a solid, and we recover about 98% of the water."

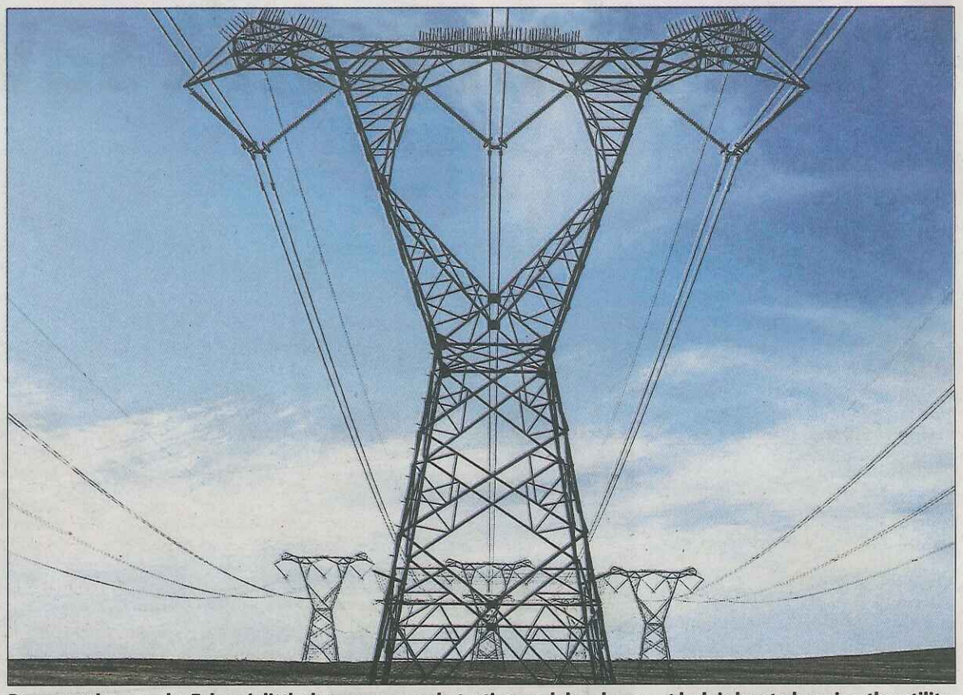
In the past, it was cheaper to "polish" water, which involved adding chemicals to the water to remove some of the salts and heavy metals. "But now water is scarcer and more valuable," says MacColl.

This is still a pilot plant, though, and would need to be scaled up significantly to cope with the quantity of contaminated water from South Africa's power stations and mines.



Meters

At the James Watt Laboratory, Shawn Papi, a senior technician — on paper — has one job: he tests electricity meters. "But it's not as simple as that," he says. "There are 11-million prepaid meters from nine different manufacturers.



Power to the people: Eskom's little-known research, testing and development hub is key to keeping the utility functioning optimally. Photo: David Harrison

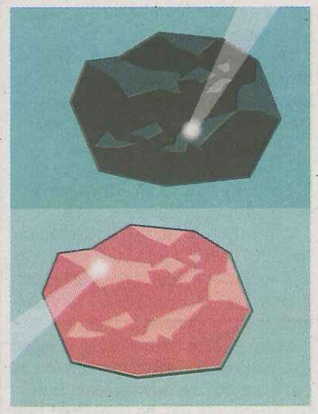
"These meters experience different environmental conditions. The northern part of the country is hot, but the Western Cape is fairly cold. We need one meter that is able to work in all of those environments."

The lab specifies that a meter must continue working for 15 years. "Even in the testing, we try to simulate 15 years," Papi says.

An additional layer of complexity is the software: the many different meters means they must be able to interact. "They all have to talk to our IT [information technology] system and the data format [must be] independent of manufacturer," Papi says.

He says Eskom does not dictate to the municipalities which meter to procure but "they often choose what we buy".

MacColl adds that an important part of the James Watt Laboratory is to "ensure that Eskom is an informed buyer".



Qemscan

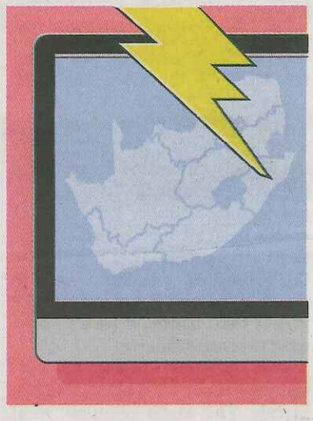
Chris van Alphen holds out two pieces of rock: the one is a shiny black, the other a grey pink. Companies tried to sell both of these to Eskom as coal, he says.

That is why the utility has a Qemscan (quantitative evaluation of minerals by scanning electron microscopy) laboratory, which is used for testing all the coal the parastatal buys and for examining the fly ash its coal-fired power stations produce. It allows Eskom researchers to determine whether someone is trying to sell the utility quartz or coal.

A boulder is pulverised into pieces of 100 micrometers each, which is about the thickness of a piece of paper. Using the Qemscan, the researchers obtain a "fingerprint" of the material and can tell what is in it. But being able to decode this fingerprint hinges on local expertise.

"The trick is mineralogical knowledge accumulated over years," says Van Alphen, who did his PhD on the minerals in South African coal.

He says his unit produces about 210 reports a year, examining coal, fly ash and samples taken from prospective new collieries.



Grid situational awareness

A giant screen covers the wall: a map of South Africa stands prominently on a grey background, with neon pink and green arteries pumping electricity around the country.

"This is where we run grid situational awareness," says Raynier van Rooyen. With the information displayed on the map, system operators are able to make decisions. "It's a visual representation of numerical data, so that you know what's going on on your grid, and any environmental factors."

For example, a serious issue for electricity infrastructure in South Africa is lightning. Parts of KwaZulu-Natal have some of the world's highest number of strikes per metre, which is dangerous for power lines. The CSIR, with Eskom as a major collaborator, developed the Advanced Fire Information System, which allows stakeholders to view fire threats in real time.

"This system is Afis on steroids," says unit head Nick Singh. Using windspeed, temperature and humidity data, "we can determine the threat level", he says.

These help system operators to make decisions. For example, South Africa has about 11 000 storms a year. "If you give your system operator 11 000 warnings, he will stop listening to you," MacColl says.

Sarah Wild is an award-winning freelance science journalist