WCB ENGINEERING BULLETIN

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The Institution of Certificated Mechanical and Electrical Engineers South Africa
Western Cape Branch (WCB)

DECEMBER 2020

MISSION STATEMENT: 1. To uphold the image and status of the Certificated Engineer. 2. To represent the Certificated Engineer at ECSA and other decision-making bodies concerning legislation, safety & health standards, the environment and the machinery regulations. 3. To promote continued education and training of its members and future engineers. 4. To promote fellowship in the engineering profession.

EDITORIAL

Welcome to the latest edition of the Western Cape News Bulletin

Has the future ever looked so uncertain? The COVID-19 pandemic has, in a few months, completely upended the way we live our lives and has, furthermore, disrupted many of the assumptions we use to predict what the future might look like. It is now very difficult to know and plan what we will be doing in the next year, let alone in three to five years' time! The wearing of face furniture (masks) has become the norm – and how often have we left home or the office – to only have to turn back to fetch our face furniture!

I found this editorial in one of our local magazines and quote it (by kind permission – Max Schutte)

"IT WAS THE BEST OF TIMES, IT WAS THE WORST OF TIMES

For most of us, this was a year such as we have never known before ... The annual *"Word of the Year"* chosen by most dictionary editors was, predictably, *Lockdown* - a word we had previously only known from prison dramas on TV, it wasn't supposed to be real was it?

The opening lines of *A Tale of Two Cities* by Dickens are a pretty good summation of 2020:
"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of light, it was the season of darkness, it was the spring of hope, it was the winter of despair ... "

With little socialising, recreational events and sports, with the surreal American election circus, unemployment and financial survival concerns, the disruption of the school year, the work-from-home experience, the lockdown level roller-coaster, essential goods only shopping, it just seemed to keep coming as the weeks and months rolled on with no timetable.

But to our credit as a society, we were largely resilient and met the challenge of COVID-19 to every part of our lives. We washed our hands, we distanced, we put on masks and we adapted to the new rules imposed on us. Our day-to-day rituals were disrupted and we realised how much our lives are based on routine. When we were denied many of our usual extravagant treats we found new satisfaction in simple home pleasures and we realised how much we had undervalued them before.

We coped with it as best as we could ... We learned how to "do COVID" and "I'm so looking forward to .... " became the common catch phrase that united us. Hopefully, when the current wave passes in a month or two and vaccines are not too far off, the worst will be behind us. We look to 2021 with a lot of hope but with the knowledge that we need to remain guarded, as we find our way back to a more normal way of life, whatever that will eventually look like. "

Then, as far as our Institution is concerned, we have not been able to present talks at meetings or arrange site visits. We have managed to hold our AGM either. As a result, we are planning – like all other businesses – to

resort to "Virtual" meetings and presentations. We, the Western Cape Branch, are planning our first virtual presentation which we hope to launch early in 2021.

And so – let us continue with this news bulletin.

In this Bulletin, we have the normal Questions and Answers for Factories and Mining GCC examinations.
A year end message from our President.
The continuation of the "Lighting up the fairest Cape 1895 to 1995" with the last part of the Appendix A which describes all the generation plants and machinery.
We also copy an email received from ECSA titled "COVID Exemption Notification CRM:0139994" – which I am sure all will be pleased with.

Any contributions to future editions of this Bulletin from members would be welcome.

I trust that you will find the content of this news bulletin interesting enough to pass on to your colleagues and friends.

Finally, we would like to wish all our members and readers of this News Bulletin a Blessed Christmas (for those celebrating Christmas) and may the new year be better than 2020 for everybody!

Stay safe and remember to wear a mask, wash your hands, sanitize and social distancing when out in public areas!

Chris Schnehage
chris@icmeewc.co.za

LOCAL BRANCH NEWS

Activities of the Western Cape Branch since the last Bulletin were as follows:

Due to the current COVID restrictions there has been no activity of the branch.
Hopefully we will be able to arrange meetings or visits soon again in 2021.

We appeal to members who have an interest to please suggest something and assist with arrangements.

Until next time, Ciao for now!

Chris Schnehage
Tel: 083 326 8023
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YEAR END LETTER FROM OUR PRESIDENT

The beginning of 2020 was just like any other year, full of hope, with individual plans and resolutions and probably with a whole host of holiday plans, etc. unfortunately it was not to be. None could have anticipated how the year would eventually turn out to be.

The year 2020 challenged our social lives in general, engagements methods, work patterns, gathering patterns, etc. We found ourselves having to conceal our mouths and noses with masks, social distancing from each other, sanitising our hands at every corner and social gatherings, sneezing into elbows, can't shake hands, limiting social gathering such as churches and weddings, even reducing the number of employees in workplaces, and many more other aspects of our daily lives. Companies downsizing even going to the extent of closing as a result increasing unemployment levels.

Sadly, the COVID-19 pandemic, like many other diseases, affected some directly or indirectly. Some amongst us were directly infected with COVID-19 or know a close relative(s) or friend(s) or even colleagues. Sadly, some succumbed to the deadly disease, COVID-19.

As the board of directors (BoD) of the Institution of Certificate Mechanical and Electrical Engineers of South Africa (ICMEESA), we wish to convey our heartfelt condolences to all our members who themselves succumbed to COVID-19 or may have lost loved ones to the pandemic. We also wish a speedy recovery to those that are or were infected.

Whilst the year 2020 turned to be difficult, it certainly gave us the gift of spending more time with our direct families without interruptions, do more with less, explore new talents, learn how to communicate, gather and worship differently through virtual technologies and working from home.

As ICMEESA we were also not spared our fair share of impacts and opportunities that were ushered in by the pandemic. The BoD and its subcommittees could not have physical meetings, the Annual General Meeting (AGM) had to be cancelled, Government Certificate of Competency (GCC) Master Class and exams had to be postponed, membership subscriptions were greatly affected and many more.

Just as the world did, ICMEESA swiftly adopted the use of technology. BoD and subcommittee meetings were resumed using virtual platforms, GCC Master Class was successfully conducted online. Plans are afoot to conduct our very first AGM virtually. We definitely have learned that virtual meetings are just as efficient if not more. It is the after meetings social gatherings that we miss so much.

ICMEESA understands that members may have been affected financially during this pandemic and therefore the BoD has resolved to not increase membership fees for this coming financial year. The BoD urge members to honour their annual membership fees as the existence and the sustainability of the Institution depends largely on such fees.

In the words of Martin Luther King, Jr, “We must accept finite disappointment, but we must never lose infinite hope.” Whilst the year 2020 may have had its share of surprises and challenges, not all hope is lost.

The joy and hope accompanied by Christmas and the ushering of a New Year still exist. This is a period to spend time with family and close friends reminiscing about the year that was, whilst planning the year that is to be.

As we celebrate our holidays season we should not, as individuals, forget the less fortunate amongst us. Spare a thought, more so find the destitute and gift them with whatever you can, donate to children’s homes. Give them the only hope that they may possibly have for 2020.

I therefore take this opportunity, as the President of the Institution of Certificated Mechanical and Electrical Engineers of South Africa (ICMEESA) and the Chairperson of the Board of Directors, to wish you a Merry Christmas and a Prosperous 2021. Happy holidays.

Stay safe and keep observing all COVID-19 related guidelines. May God Bless South Africa and all her people.

Eddie Singo
ICMEESA President

EMAIL FROM ECSA REGARDING CPD

ENGINEERING COUNCIL OF SOUTH AFRICA

13 December 2020

Dear Registered Person,

RE : EXEMPTION FROM CPD REQUIREMENTS

Following an outbreak of the Coronavirus (COVID-19) and the impact of the lockdown in South Africa from March 2020, the Engineering Council of South Africa (ECSA) resolved to relax the Continuing Professional Development (CPD) requirements and to exempt all Registered Persons from complying with the requirements for the current year, 2020.

This exemption is automatic and will be implemented by Council as follows:
All practitioners registered in the professional or specified categories will be exempted from obtaining five (5) credits for the year 2020. These credits make up five (5) credits of the twenty-five (25) credits for the five (5) year cycle required in order to renew your registration(s) and will be distributed amongst the three CPD categories as stipulated below:

CPD Categories	Activity	Number of exempted credits
Category 1	Developmental Activities	1
Category 2	Work-based Activities	2
Category 3	Individual Activities	3
Total		**5**

In terms of Section 22(1) of the Engineering Professions Act, the Registered Person must still apply in the prescribed manner to Council for the renewal of his or her registration.
ECSA would like to wish all Registered Persons good health during these trying times and to express our gratitude for the continued support.
Yours Faithfully

Ms Carmen Wright

Manager: Education and CPD

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OHSAct, Nov. 2013 (4) (DMR)

[**4.1**] Define the following terms stipulated in the Driven Machinery Regulations 1988 as amended:
4.1.1 Point of operation
4.1.2 Lifting Machine **[2]**
Answer: See DMR definitions

4.2 What must be fitted to a wood-planning machine which is used for overhand planning and which is not mechanically fed? **[1]**
Answer: 5

4.3 In your workshop an employee has to apply a work piece to the grinding wheel of a power-driven grinding machine by hand.
At what position must the work rest be adjusted and fixed? **[1]**
Answer: 8(5)

4.4 You are manufacturing transportation trailers for the agricultural industry and the body parts is of such a nature that during the pressing operation the opening at the point of operation of the hydraulic press is 40 mm.
Describe TWO methods of safeguarding you could consider for safety. **[2]**
Answer: 9(1)(a)(b)(c)(d)(e) & 9(2)

4.5 Name FOUR design requirements for a lifting machine. **[4]**
Answer: 18(1)(a)(b)(c) & 18(2)(a)
18(2)(b)(i)(ii) & 18(3) & 18(4)

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Plant Eng. Nov. 2020 (5.2)

A new flanged shaft coupling has to be designed after the previous coupling has disintegrated. The shaft needs to transmit 45 kW at 140 rpm. 18 mm diameter bolts are used on a 180 mm diameter pitch circle. The maximum torque is 1,3 times the mean and the shear stress in the bolts is limited to 30 MPa.
Calculate the following:

5.2.1 Maximum torque that will be transmitted. [4]

5.2.2 Number of bolts required. [4]

Suggested answer:

5.2.1

$$T_{mean} = \frac{45000 \times 60}{2\pi \times 140} = 3069 \text{ Nm}$$

$$T_{max} = 1.3 \times 3069 = 3990 \text{ Nm}$$

5.2.2

Torque on all bolts = 3990 Nm

$$\text{Force on all bolts} = \frac{3990}{0.09} = 44.34 \text{ kN}$$

$$\text{Bolts area} = \frac{44340}{30 \times 10^6} = 1.478 \times 10^{-3} \text{ m}^2$$

$$\text{Area / bolt} = \pi \times 0.009^2 = 2.545 \times 10^{-4} \text{ m}^2$$

$$\text{No of bolts required} = n = \frac{1.478 \times 10^{-3}}{2.545 \times 10^{-4}} = 5.8 \text{ say 6 bolts}$$

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Jorge Pereira GCC Preparation Classes (Pty) Ltd.
Part-time GCC classes in Cape Town
For details contact Jorge Pereira at
082 896 8489 or ***jorgepereira43@yahoo.co.za***

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Plant Engineering: MINES electrical question

Question (June 2006, Question 5.1)

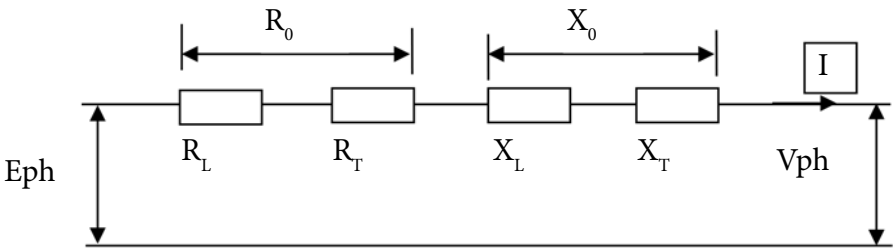
A three-phase load of 3 000 kVA, 0,8 power factor, is supplied at 11 kV from a step-down transformer having a ratio of 3:1. The primary side of the transformer is connected to a transmission line, the constants of which are: resistance per conductor, 2 ohms; reactance per conductor 3 ohms. The resistance and reactance per phase of the primary windings of the transformer (which are star-connected) are 5 ohms and 10 ohms respectively, and the corresponding values for the secondary windings (which are delta-connected) are 1,5 ohms and 3 ohms respectively.

Determine the voltage and power factor at the sending end of the transmission line. [10]

Proposed Solution:

The transformer is connected star-delta and has a line voltage ratio of 3:1. Therefore the phase voltage and turns ratios are √3:1.

Let the resistance and reactance of both sides of the transformer be referred to the primary side.



Equivalent resistance per phase = $5 + (\sqrt{3})^2 \times 1,5 = 9,5$ ohms $= R_T$

Equivalent reactance per phase $= 10 + (\sqrt{3})^2 \times 3 = 19$ ohms $= X_T$

Therefore, including the constants of the transmission line, the total resistance per Phase
$= 2 + 9,5 = 11,5$ ohms $= R_o$

Total reactance per phase $= 3 + 19 = 22$ ohms $= X_o$

Load phase voltage referred to the primary = $11\sqrt{3}$ kV $= 19,05$ kV $= V_{ph}$

If the magnetizing current is small enough to be neglected, then the primary current

$$I = \frac{300 \times 10^3}{\sqrt{3} \times 33 \times 10^3} = 52,49 \text{ amperes.}$$

Let the current I be the reference vector $I = 52,49\ (1 + j0)$ amperes

Now, since the load power factor is 0,8 (assumed lagging), therefore CosØ = 0,8
And sinØ = 0,6, and the load phase voltage $V_{ph} = 19,05(0,8 + j0,6)$ kV $= 15,24 + j11,43)$ kV

Total impedance drop referred to the primary = IZ_o

$= 52,49\ (11,5 + j22)$ volts

$= 603,9 + j1154$ volts

$= 0,6039 + 1,154$ kV

Then $Eph = Vph + IZo$

$= (15,24 + j11,43) + (0,6 + j1,154)$

$= 15,84 + j12,58$ kV

$= 20,23$ kV

Line voltage at the sending end = Eph × √3 = 20,23 × √3 = 35 kV

Phase angle at sending end = $\tan^{-1}$[12,58/15,84] = 38° 27' = 0,783 lagging

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A Legal Knowledge: MINES question

Question (November 2020, Question 10):

The conveyor belt COP must address eight requirements to prevent injuries during installation, extension, dismantling, transportation and re-installing of conveyor belt installations due to the installation collapsing, the belt breaking or running away. What are those requirements?

[10]

Proposed answer

8.2 Installation, extension, dismantling, transport and re-installation

In order to prevent persons from injury during installing, extension, dismantling, transportation and re-installing of conveyor belt installations due to the installation collapsing, the belt breaking or running away, the COP must at least address the following:

- Means of installing the conveyor belt safely;
- Means of cutting, joining and extending any belt safely;
- Means of clamping any belt safely;
- Means of pulling any belt in safely;
- The chemicals to be used during belt extensions and measures to address the risks associated with such chemicals;
- Means of transporting any belt and structure to its new site or position;
- Means to test the conveyor belt installation after installation and extension; and
- Supporting the roll of belting on trestles

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Lighting up the Fairest Cape .... Continued

APPENDIX A (Part two)
(of the book Lighting up the Fairest Cape – written and compiled by Dennis Palser)

SALT RIVER NO.1 POWER STATION (ESKOM)

This was the first thermal power station to be built and operated by Escom, now officially known as Eskom.

First Stage (1928)

3 - Turbo-alternator sets.
Howden turbines.
English Electric, U.K.
10 000 kW, 12 000 V, 50 Hz, three-phase.

2 - Boilers.
Chain-grate, stoker-fired type.
Babcock and Wilcox.
60 000 pounds of steam per hour at 270 psig and 700°F (370°C).

Commissioned 1928

Station total installed generating capacity .....**30 000 kW**

This first stage, comprising the three 10 000 kW sets, generated electricity for the first time on 15 February 1928.

Second Stage (1933-1935)

3 - Turbo-alternator sets.
C A Parsons and Co., U.K.
20 000 kW, 33 000 V, 50 Hz, three-phase.

These latter units were the first turbo-alternator sets in South Africa to generate directly at 33 000 V.

6 - Boilers.
Chain-grate stoker-fired type.
Babcock and Wilcox.
100 000 pounds of steam per hour at 425 psig and 750°F (400°C).

Commissioned (final) 1935

Station total installed generating capacity .....**90 000 kW**

The three 20 000 kW sets of this second stage were progressively installed and commissioned over the period 1933 to 1935.

The station was decommissioned in 1979 after more than half a century of service.

TABLE BAY POWER STATION

First Stage (1936-1939)

3 - Turbo-alternator sets.
C A Parsons and Co., U.K.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
40 000 kW CMR (continuous maximum rating).
(32 000 kW economic rating).
(50 000 kW overload rating).

These turbo-alternators were later uprated from 40 000 kW to 45 000 kW units by replacing the original 34-inch diameter rotor units with 36-inch rotor sets, one in 1956 and the other two in 1959.

6 - Boilers.
Chain-grate, stoker-fired, water-tube type.
Babcock and Wilcox.
230 000 pounds of steam per hour at 625 psig and 825°F (440°C).

Station total installed generating capacity ..... **120 000 kW**

This station was the first in South Africa to operate at a steam pressure higher than 425 psig.

Second Stage (1949)

1 - Turbo-alternator set.
C A Parsons and Co., U.K.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
42 000 kW CMR (continuous maximum rating).

2 - Boilers.
Chain-grate, stoker-fired, water-tube type.
Babcock and Wilcox.
230 000 pounds of steam per hour at 625 psig and 825°F (440°C).

Station total installed generating capacity ..... **162 000 kW**

Third Stage (1952)

1 - Turbo-alternator set.
C A Parsons and Co., U.K.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
42 000 kW CMR (continuous maximum rating).

1 - Boiler.
Chain-grate, stoker-fired, water-tube type.
Babcock and Wilcox.
230 000 pounds of steam per hour at 625 psig and 825°F (440°C).

Station total installed generating capacity ..... **204 000 kW**

The station went into full commercial operation with all five sets on 1 February 1953.

Fourth Stage (1957)

1 - Boiler.
Chain-grate, stoker-fired, water-tube type.
Babcock and Wilcox.
230 000 pounds of steam per hour at 625 psig and 825°F (440°C).

At the end of 1959, after the uprating of the first three turbo-alternators from 40 MW to 45 MW sets, and along with the last two 42 MW units, the total rating of the station was at its ultimate installed capacity of 219 MW.

Station total installed generating capacity ..... **219 000 kW**

The station was decommissioned in 1983 and demolished over a three-year period from 1986 to 1989.

SALT RIVER NO.2 POWER STATION (ESKOM)

First Stage (1955-1957)

4 - Turbo-alternator sets.
Metropolitan Vickers, U.K.
12 000 V, 50 Hz, three-phase.
30 000 kW.

6 - Boilers.
Chain-grate stoker-fired type.
Babcock and Wilcox.
260 000 pounds of steam per hour at 635 psig and 915°F (490°C).

Station total installed generating capacity ..... **120 000 kW**

The steam temperature of 915°F was the highest of any power station in South Africa at the time.

The first set in this station commenced generation in April 1955.

Second Stage (1967)

2 - Turbo-alternator sets.
Hydrogen cooled.
Escher Wyss-Oerlikon, Switzerland.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
60 000 kW (CMR).

4 - Boilers.
Chain-grate stoker-fired type.
Babcock and Wilcox.
260 000 pounds of steam per hour at 635 psig and 915°F (490°C).

Station total installed generating capacity ..... **240 000 kW**

The station was decommissioned on 29 July 1994.

ATHLONE POWER STATION

First Stage: Initial (1957)

2 - Turbo-alternator sets.
Oerlikon Engineering Company, Switzerland.
Twin cylinder, impulse type, with single exhaust.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
30 000 kW.

3 - Boilers.
Chain-grate stoker-fired type.
John Brown Land Boilers (Africa) (Pty) Ltd.
Stop valve steam pressure 635 psig at 915°F (490°C).

The first boiler underwent final inspection by the Inspector of Machinery on 26 October 1960, and a provisional permit was granted to raise pressure and steam the boiler. Soon afterwards, on 8 November 1960, the first turbo-alternator was run up and connected to the system for testing purposes, but because of balancing and adjustment problems this unit only became available for regular operation on 11 January 1961. The second turbo-alternator was placed in commercial operation soon after the first.

First Stage: Optional (1958)

1 - Turbo-alternator set.
Oerlikon Engineering Company, Switzerland.
Twin cylinder, impulse type, with single exhaust.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
30 000 kW.

1 - Boiler.
Chain-grate stoker-fired type.
John Brown Land Boilers (Africa) (Pty) Ltd.
Stop-valve steam pressure 635 psig at 915°F (490°C).

Station total installed generating capacity .....**90 000 kW**

This third turbo-alternator was placed in commercial operation later in the year, soon after the second, thereby making available a total of 90 MW of extra generating capacity on the Council system. Initially this plant was operated daily on a two-shift basis only, but the following year, 1962, it was run on a continuous three-shift basis throughout the year to meet the increased night-load on the Council's stations.

The power station was officially opened by the Mayor, Councillor A H Honikman, on 15 August 1962, and named the Athlone "A" power station.

Second Stage: Initial (1963)

1 - Turbo-alternator set.
Oerlikon Engineering Company, Switzerland
Twin cylinder, impulse type, with single exhaust
12 000 V, 50 Hz, three-phase, 3 000 rpm.
30 000 kW.

2 - Boilers.
Chain-grate stoker-fired type.
John Thompson Africa (Pty) Ltd.
Stop-valve steam pressure 635 psig at 915°F (490°C).

By the end of 1963 a fourth turbo-alternator and fifth boiler had been commissioned, further raising the available capacity of the station to 120 MW.

Second Stage: Optional (1964)

1 - Turbo-alternator set.
Oerlikon Engineering Company, Switzerland.
Twin cylinder, impulse type, with single exhaust.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
30 000 kW.

1 - Boiler.
Chain-grate stoker-fired type.
John Thompson Africa (Pty) Ltd.
Stop-valve steam pressure 635 psig at 915°F (490°C)>

Station total installed generating capacity ..... **150 000 kW**

Third Stage (1965)

1 - Turbo-alternator set.
Single cylinder type.
Hitachi, Japan.
12 000 V, 50 Hz, three-phase, 3 000 rpm.
30 000 kW.

1 - Boiler.
Chain-grate stoker-fired type.
John Thompson Africa (Pty) Ltd.
Stop-valve steam pressure 635 psig at 915°F (490°C).

Station total installed generating capacity ..... **180 000 kW**

This sixth turbo-alternator and eighth boiler went into commercial operation on 1 April 1967, some ten years after the first contracts were placed. The station was now fully equipped to its ultimate generating capacity of 180 MW.

STEENBRAS POWER STATION

4 - Reversible Pump-Turbine Motor-Generator sets.
Pump-Turbines: Francis type.
Escher Wyss Ltd, Switzerland.
Motor-Generators: Salient-pole, synchronous type.
Siemens Ltd, West Germany.
12 000 V, 50 Hz, three-phase.
45 000 kW.

Station total installed generating capacity ..... **180 000 kW**

The station was formally opened by the Mayor, Alderman Ted Mauerberger, on 8 August 1979.

Among the distinguished guests present was Dr H Olivier, the President of the South African Institute of Civil Engineers, who unveiled a presentation plaque marking the Institute's recognition of the civil engineering works associated with the scheme as the most outstanding civil engineering project completed during 1978.

Steenbras power station has the distinction of being the first hydroelectric pumped-storage installation to be built and commissioned in South Africa, and probably also the very first on the African continent.

Appendix B in next edition…