



WCB ENGINEERING BULLETIN

Vol.30 No2



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

JUNE 2021

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

Membership Fees:

I would like to thank all members who have paid their fees for 2021 thus far this year.

However, a number of payments have been received which do not have clear information on who has made the payment! – **while the invoice clearly states to please use the invoice number as a reference!** This is not a good state of affairs as such a payment cannot be credited to whoever made the payment. So, PLEASE let us know should you be aware of your company making a payment and you suspect an incorrect reference has been used. THANK YOU!

Annual General Meeting:

The Annual General Meeting of the Institution was held on 10 June making use of the virtual Zoom platform. It turned out to be very successful with the change in office bearers, being Immediate Past President/Chairperson of the Board, Eddie Singo, handing over to the incoming President/Chairman of the Board, Mr. Bernard Bryers.

Report is included in the news Bulletin.

In this Bulletin, we have the normal Questions and Answers for Factories and Mining GCC examinations. There one article taken from the ICMEESA Archives – from The Certificated Engineer volume 39 – 1969. It is in more than one part as it is a fairly lengthy article.

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.

Chris Schnehage

chris@icmeewc.co.za

LOCAL BRANCH NEWS

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

We have not had any specific Branch activity during the year so far due to the continued COVID Pandemic.

However, we arranged a very successful talk on Solar power making use of the virtual Zoom platform. There were 29 people who participated in the event and all found the presentation useful and effective.

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

Email: chris@icmeewc.co.za

OHSAct, June 2013 (5) (CR)

[5.1] Define the following terms as given in the Construction Regulations, 2003.

5.1.1 Competent person

[2]

5.1.2 Scaffold

[1]

Answer: See definitions

5.2 Who must supervise formwork and support work operations?

[1]

Answer: 10 (a)

5.3 What are the design criteria for formwork and support work structures?

[2]

Answer: 10 (b) & (c)

5.4 When must formwork and support work structures be inspected?

[1]

Answer: 10 (e) & (f)

5.5 Apart from the provisions of the Driven Machinery Regulations for lifting machines, state THREE additional requirements in the construction regulations when tower cranes are used on a construction site.

[3]

Answer: 20

Jorge Pereira GCC Preparation Classes (Pty) Ltd.

GCC Part-time classes in Cape Town

For details contact Jorge Pereira at

082 896 8489 or

jorgepereira43@yahoo.co.za

Plant Eng. Nov. 2011 (7.1)

A factory takes 600 kVA at a lagging power factor of 0,6. A synchronous motor is to be installed to raise the power factor to 0,9 lagging when the motor is taking 200 kW. Calculate the corresponding kilovolt amperes taken by the synchronous motor and the power factor at which the motor will be operating.

[10]

Suggested answer:

Considering the factory alone:

$$P1 = 600 \times 0,6 = 360 \text{ kW}$$

$$Q1 = 600 \times 0,8 = 480 \text{ kVAr}$$

Considering the factory and SM:

$$P2 = 360 + 200 = 560 \text{ kW}$$

$$Q2 = 560 \times 0,484 = 271,221 \text{ kVAr}$$

Considering the SM alone:

$$Q_{sm} = 480 - 271,221 = 208,8 \text{ kVAr}$$

$$S_{sm} = 200 + j208,8 \text{ kVA}$$

$$S_{sm} = \mathbf{289,133 \angle -46,233^\circ \text{ kVA}}$$

$$PF_{sm} = \cos 46,233^\circ = \mathbf{0,692 \text{ leading}}$$

Additional question:

What is the final rating power of the factory after the SM has been installed?

$$S_2 \text{ factory} = 560 - j271,221 \text{ kVA}$$

$$S_2 \text{ factory} = \mathbf{622,22 \angle -25,842^\circ \text{ kVA}}$$

$$PF = \cos 25,842^\circ = \mathbf{0,9 \text{ lagging}}$$

By installing a SM to improve the power factor of the factory, the total rating power of the factory increases from 600 kVA to 622,22 kVA.

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Plant Engineering: MINES mechanical question

Question (June 1991, Question 5)

- i) For the purpose of a test, a 100 m length of conveyor structure is laid horizontally and equipped with belting having a mass of 15 kg/m. When this empty belting is driven at a speed of 2 m/s the power required at the driving drum is 5 kW.

Calculate the coefficient of idler friction.

(5)

- ii) The same type of structure is installed in a roadway and operates over a distance of 800 m on an adverse gradient of 1 in 7. The conveyor is required to carry 260 t/h when driven at the test speed.

Assuming a drivehead efficiency of 78% calculate the capacity of the motor required to drive the installation. (15)

[20]

Proposed Solution:

- i) The concept employed to resolve this problem is that of power in = power out.

Given that the power in = 5 000 watts and belt velocity is 2 m/s;

5 000 = friction force times velocity

$$\therefore \text{friction force} = \frac{5000}{2} = 2500 \text{ N}$$

Now friction force = normal force times coefficient of friction and

the normal force = mass of belting on idlers times g, where mass of belting is $100 \times 15 = 1500 \text{ kg}$

$$\text{Thus, } 2500 = \mu \times 1500 \times 9,81 \quad \therefore \mu = 0,17$$

- ii) The angle at which the conveyor is installed is given by:

$$\tan^{-1} \frac{1}{7} = 8,13^\circ$$

Mass delivered by the conveyor per second is given by

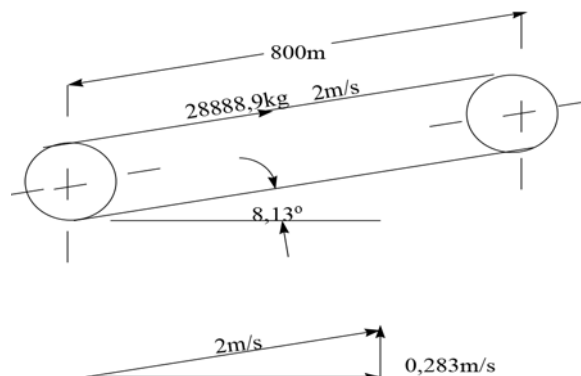
$$m = \frac{260000}{3600} = 72 \times 222 \text{ kg}$$

Mass moved by the conveyor

$$= \frac{800}{2} \times 72 \times 22$$

$$= 28888,9 \text{ kg.}$$

Power required to raise load = force times vertical velocity where vertical velocity = $2 \sin 8,13^\circ = 0,28284 \text{ m/s}$.



Thus, power for raising $28888,9 \times 9,81 \times 0,28284 = 80160$ watts and
 power to overcome friction = $8 \times 5 = 40 \text{ kW}$ $\therefore P_t = 80 + 40 = 120 \text{ kW}$

A Legal Knowledge: MINES question

Question (November 2019, Question 6):

According to Section 7 of the MHSA, an employer is responsible for the staffing of a mine with regards to health and safety. Mention 5 requirements that the employer must comply with.

[10]

Proposed answer

7. Employer to staff mine with due regard to health and safety

(1) As far as reasonably practicable, every employer must-

- (a) ensure that every employee complies with the requirements of this Act;
- (b) institute the measures necessary to secure, maintain and enhance health and safety;
- (c) provide persons appointed under subsections (2) and (4) with the means to comply with the requirements of this Act and with any instruction given by an inspector;
- (d) consider an employee's training and capabilities in respect of health and safety before assigning a task to that employee; and
- (e) ensure that work is performed under the general supervision of a person trained to understand the hazards associated with the work and who has the authority to ensure that the precautionary measures laid down by the employer are implemented.



If you think Veasey's Engineering College can assist you in your studies towards your GCC, visit our site at www.veaseys.co.za or contact Caitlyn Jones at info@veaseys.co.za.

We also have a social media presence on:



The AGM of the Institution was held on 10 June and the following are a few items discussed during the meeting.

Report by the Outgoing Chairperson – Presidents Review - Mr. Eddie Singo

Dear members

The past two years have once again been busy only to be crowned with the COVID-19 epidemic since March 2020. The advent of COVID-19 challenged the status quo the world over. Impositions of COVID-19 related lockdowns restricted movements and how humanity congregates. For a while, the world went into a standstill mode not knowing what to do to remedy the situation. Organisations, companies, and economies were slowed down to the extent of shedding job.

Professional Institutions such as the Institution of Mechanical and Electrical Engineers of South Africa (ICMEESA) were not spared the indirect impact thereof. Some members could not honour their annual subscription fees as a result. Members of the Board of Directors (BoD), Executive Committee (EXCO) and portfolio committees are nimble-footed and swiftly adopted the new normal of virtual meetings and engagements putting tremendous amount of time and effort into re-operationalising the Institution.

On behalf the Institution, I would like to extend my gratitude to all Members of the BoD, EXCO and Portfolio Committees for the levels of commitment displayed throughout this difficult period. You are saluted.

The Institution also bid farewell to our long-time company secretary, Ms Mariana Jacobs, who served the Institution with great distinction. The Institutions wishes her well in her new endeavours.

The Institutions extends its appreciation to Member of BoD, Mr. Christopher Schnehage, who took up the role of an Acting Company Secretary which will remain until further notice. Your efforts and time spent on the Institution is not going without notice.

This annual report serves to provide a summary of the actions taken during the past two years. In this report, the extent of the matters attended to are not necessarily limited to what is reflected.

Government Certificate of Competency:

Presentation of GCC Masterclasses prior to the sitting of the examinations for the GCC. These were put together as one day seminars with Electrical and Mechanical tutor sessions covering various matters that would assist GCC Candidates to write the examinations.

These Masterclasses were presented in May and November 2019 and were well attended.

As a result of the COVID 19 pandemic, the GCC Examinations usually set for June were cancelled.

The GCC Masterclass sessions were presented virtually in November 2020 by making use of the Zoom platform over a period of a week with one-hour sessions each day. The virtual Masterclass proved to be successful.

Members of the Institution were called upon to assist with the marking of the papers under the watchful eye of the Department of Labour Board of Examiners.

2020 has been a tough year for all concerned. The AGM scheduled date in the past was March of each year, and 2020 was to be the first year that the AGM would be held in June of each year. This is to allow for the Annual Financial Audit to be complete in time to present to members. The consequence of this was that the AGM was not held, and the Board members continued to serve in their roles.

The Board members for 2021/2022 is as follows:

Chairperson/President	B Bryers
Immediate Past Chairperson	E Singo
First Vice President	M J Borman
Second Vice President	Vacant
Honorary Treasurer	ON Letsholo
Branch Chairpersons:	
North West	Vacant
Western Cape	C W Schnehage
KwaZulu-Natal	B Bryers
Free State	I D Buchanan – liaison
Eastern Cape	G L Clack
Gauteng	M J Borman

Additional Members

BA Clark
SJ Kloppers
L Bosaletsi
H Lambert
C W Schnehage
I D Buchanan
GL Clack



Brief CV of Mr. Bernard Bryers As read by E Singo.

Bernard was born and educated in England gaining a Higher National Diploma in mechanical engineering. He came to SA in 1972 courtesy of ISCOR and joined their projects team in Vanderbijlpark building a new Hot Strip Rolling Mill.

He fell in love with country and the people but decided to join Hulett's Sugar in Durban as a project engineer in their Technical Management Department providing a project management service to their 5 KZN Sugar Mills eventually moving on to AECI joining their projects team based at the Ammonia Plant at Amanzimtoti. Realising the career advantages of gaining a Government Certificate of Competency he studied whilst at AECI and passed in 1983 which opened up numerous career opportunities at Engineering Manager level with Corobrik and Dunlop tyres eventually retiring to the UK in 1999 back into the bosom of his family.

Africa however started itching away and he realised he wanted to return, which he did in 2003 and came out of retirement as a Mechanical Engineering Consultant taking on project work in Sugar, Brick Making and the Mining Industries.

Quite a varied career and I suspect he will take on more projects if they come along.

His service to ICMEESA has been as KZN Branch Chairman and ICMEESA board member since 2009.

Message by Incoming Chairperson - Mr. Bernard Bryers

Good evening everyone it is an honour to be here as the 2021 ICMEESA Chairperson.

Eddie has given you a summary of my engineering experience and service so far to ICMEESA and may I say I am really looking forward heading up the Board to get our organisation through the Covid period and grow its service to members.

The Institution has been in good hands however and we have survived Covid, adjusted our ways and come out fighting to grow the Institution through the remaining Covid period. Many things have changed in the world with modern internet technology and Covid has accelerated this through necessity.

The business world in South Africa and our economy has shrunk and so has our membership, reducing our income and therefore our Institution's security and flexibility in choosing projects for the benefit of our members.

My emphasis in this coming Institution year will be to promote useful benefits to our members so that they feel more and more that being a member of ICMEESA is a real benefit to them.

Our constitution states quite clearly:

Clause 1.4.2

Regular formal and informal communication to and between members to promote member interaction, fellowship and ongoing professional development of the Certificated Engineer.

Clause 1.4.4

Active participation at branch level to promote members interaction and provide a platform for professional social networking.

Covid of course has changed that for our board and branch meetings, we have been having Zoom virtual meetings for our board meetings.

At branch level however, over the past few years many branches have ceased operating, which has been accelerated by Covid. In the short term to counter this we are organising national virtual zoom talks to all our members – the first being on the 29th June on Solar Power for Industry. I will be proposing that we get our branches alive again through local Zoom meetings and post Covid we endeavour to get regular face to face meetings going throughout the country.

Thank you for nominating me as Chairperson I am looking forward the year ahead.

With Covid we are meeting at board level and EXCO level through Zoom ----- which works for us and supports the board in carrying out its duties

Ongoing engineering knowledge and development by gaining CPD points and remaining a professional engineer.

Active interaction through meetings at branch level and sharing engineering problems.

The world and technology have changed, ICMEESA has had to change accordingly and will need to continue to change as South Africa emerges from COVID with a different workplace.

In this coming year our board will have to adjust to these changes some we can see happening and some maybe not to continue providing a useful service to our members.

Our constitution states:

ICMEESA will provide the following for its members:

Ongoing engineering development through CPD points

Social contact

Sound Interaction between members

Active participation at branch level to provide a platform for professional social networking.

All constitutions are up for amendment through the right procedures and support so we must look at a few clauses in our constitution and review them.

The Board of Directors wish to thank all persons attending the AGM for their attendance and participation in the proceedings.



ELECTRICITY GENERATION AND THE GAS TURBINE

By W. U. SNELL (Visitor)

ABSTRACT

PROBLEMS associated with growth in the electrical system and consistencies in the pattern of demand throughout the world. The load factor in utilities serving areas of vastly differing industrial activity. The daily and seasonal fluctuations in the demand and their influence on the operating economics of different types of generating plant. Some shortcomings in a predominating hydro-electric generating system and the benefits accruing from the inclusion of a proportion of gas turbine generating plant. The fallacy of using obsolescent steam generating equipment for emergency and peak loads. The apportionment of the load between hydraulic, thermal and nuclear generating equipment to achieve the best overall results.

An introduction to the prime mover with comments on the advantages of a separate jet type gas generator with a description of the twin spool design. Special technical features and modifications necessary to meet the demands of industrial operation. The power turbine and details of the prototype installation. Operational requirements of the turbo generator, performance, fuels and general economics. Larger gas turbines and their practical application to the electrical system in the base load power station and at a load centre.

The importance of professionally engineered power station buildings. The most economical layout and the influence of capital expenditure on the overall cost per unit. Suggestion for a compact multiple gas turbine station for standby in a unit construction base load power station. The packaged power station and modern method of construction. decentralised power stations and waste heat utilisation. A typical application and the heat balance sheet. Future developments leading to the total energy distribution centre.

CONTENTS

The Electrical Utility:

The problem of growth. The fluctuations in demand.

Economics of generation.

Apportioning the load.

The Gas Turbo Generator:

The gas generator.

The power turbine.

Practical Applications:

Prototype installation.

Operational requirements

70 MW peak load stations

Larger gas turbines,

17½ MW standby units.

Decentralised Power Stations:

Packaged power stations.

Waste heat utilisation.

Total energy distribution.

THE ELECTRICAL UTILITY

The Governments of all nations are concerned with the problem of economic growth and among the more important aspects is the supply and distribution of energy, a prerequisite of sustained industrial progress and increased domestic comfort. One of the most convenient forms in which energy can be used is electricity so that in almost every country in the world efforts are being made to increase the available capacity and to improve the pattern of consumption to ensure the most economic use of existing resources

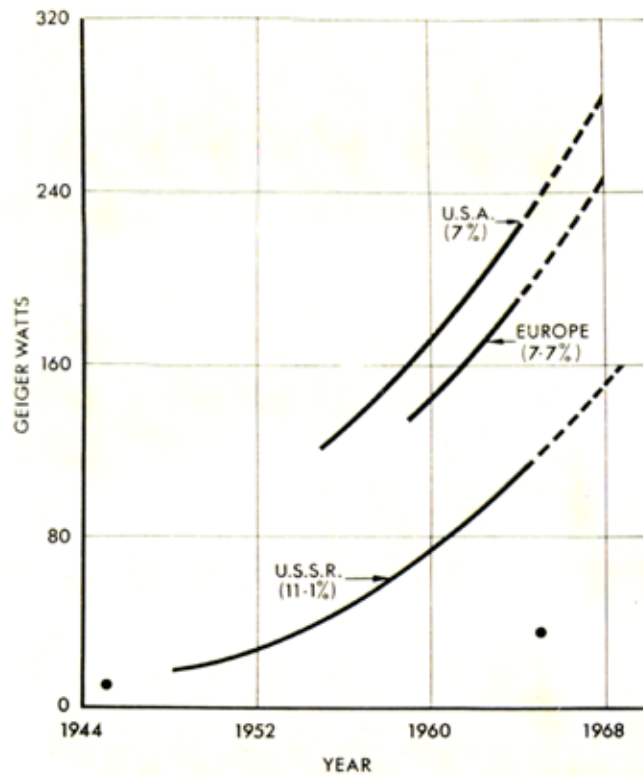


Fig. 1
Growth of major electrical systems.

In 1964 the total production of electricity was 3043×10^9 kWh, approximately three-quarters thermal, the remainder hydraulic power. If we accept conditions in Europe as typical, where capacity is increasing at the rate of over 6000 MW per annum the majority of new construction is in the form of steam and to a diminishing extent, hydroelectric. As it takes about five years to build and commission a modern base load power station it is important that the electrical utilities plan sufficiently ahead and make available the necessary capital to ensure that the facility is operational when required (Fig. 2).

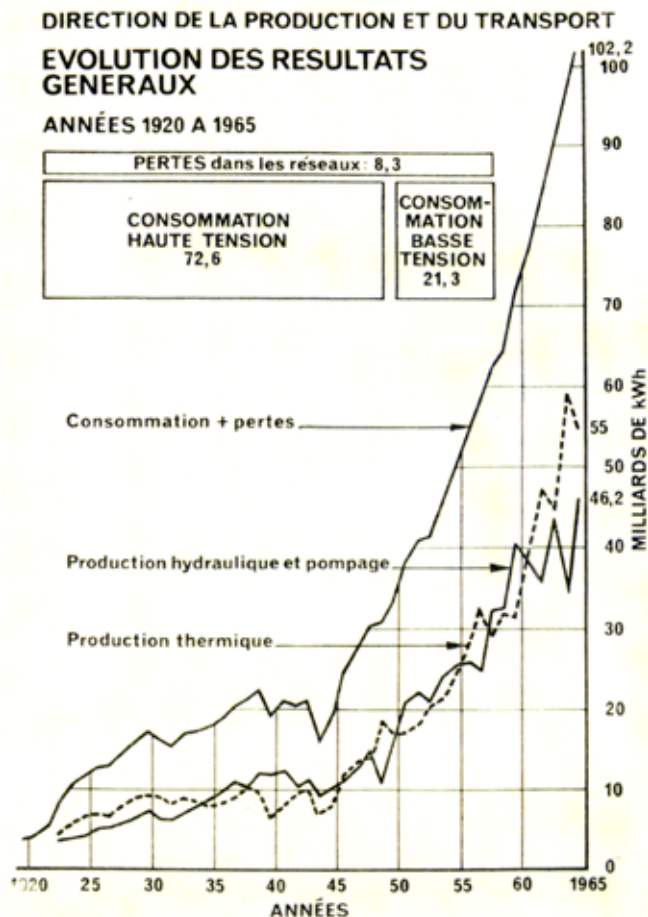
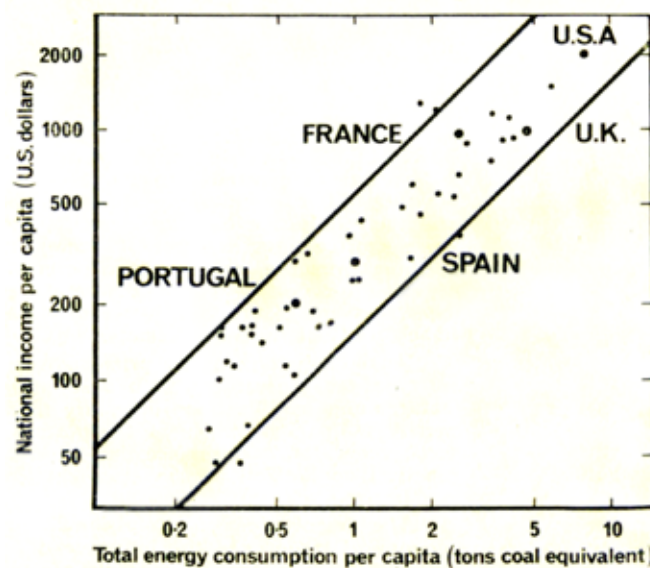


Fig. 2
Growth Electricité de France - thermal and hydraulic.

In temperate climates capacity is related to the estimated maximum demand in average cold spells augmented by about 15 per cent to provide a margin for weather of abnormal severity or breakdown in the plant and minor deviations from the general growth curve. In at least one major European utility the rate of increase in demand over the past few years has so far exceeded the rate of new construction that this reserve has virtually disappeared.

In general, a close relationship exists between industrial productivity and the use of electrical energy in the factory, an improvement of 1 per cent in output being accompanied by an increase of 2 per cent in the consumption of electricity. The consequential gain in prosperity is reflected by a further increase in the use of electrical equipment in the home as more people are able to afford this convenient source of energy which, as far as the housewife is concerned, is flexible in operation, clean to handle, available on request and does not require the installation of costly appliances (Fig. 3).



Total energy consumption per capita (tons coal equivalent)

Fig. 3

Relationship between national income and energy consumption.

An electricity utility is faced with daily fluctuations in the demand superimposed on seasonal variations which together can amount to two-thirds of the maximum load. Consumer demand curves are depicted for average days in mid-winter and high summer, typical of European weather. These have been replotted to indicate the range of the demand related to its duration (Fig. 4).

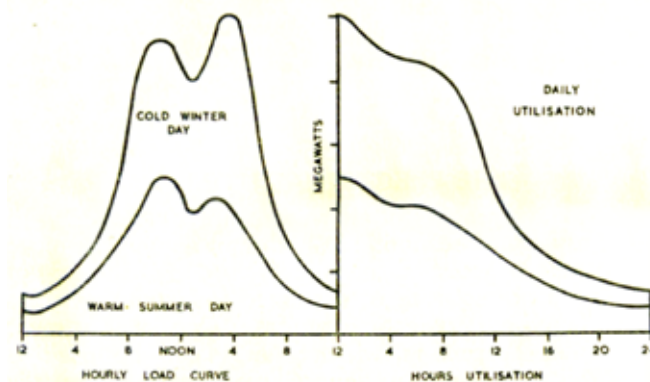


Fig. 4

Typical daily load curve.

The summation of all the separate daily load curves throughout the year represents in convenient form the annual utilization of the facility. The ratio between the mean and maximum values is termed the load factor. Fig. 5 shows the extreme range of loading conditions under which the electrical utilities are expected to operate.

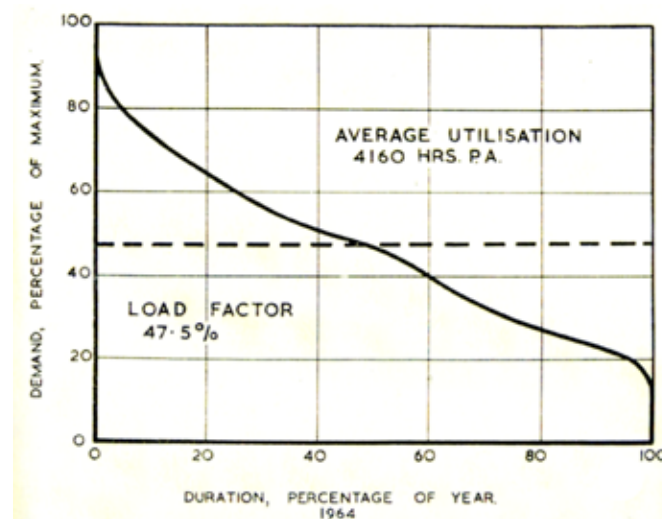


Fig. 5
Annual utilization, British electrical system.

No satisfactory means of storing electrical energy on a commercial scale close to the Consumer has yet been devised so that generating and distributing equipment, power stations, cables, transformers and so on costing many millions of pounds to construct are used for only part of the time. In efforts to correct this situation promotional tariffs have been introduced to encourage the consumer to improve the pattern of consumption.

A reduction in the price per unit is offered in exchange for a restriction in the use of the facility either to submit to power cuts on selected appliances arbitrarily imposed by the supplying authority through some form of ripple control or an optional limitation accepted by the customer curtailing requirements to 'off peak' periods. There is, however, a limit to the inducement which can be offered and experience indicates that the consumer will continue to demand power at peak periods at an acceptable price.

The automation of production increases plant utilization while the reduction in hours of work has a contrary effect. Moreover in an advancing economy the domestic load becomes of increasing importance, bearing a large share of the responsibility for the peak demand. If the utilities cannot or will not oblige when electricity is at a premium then the energy will be supplied in some other form and the electrical supply industries will lose a considerable proportion of their more profitable demand.

The world consumption of electricity plotted over the ten years to 1964 indicates a rate of growth of 8 per cent per annum, i.e. the load doubles every ten years or so while plant utilization remains practically unchanged at an average factor of about 47.5 per cent irrespective of the stage of industrial development or the extent and location of the system. Means of meeting the maximum demand should be considered on the basis that the load factor will remain constant with increasing consumption albeit more unpredictable as the comfort load becomes of greater Importance (Fig. 6).

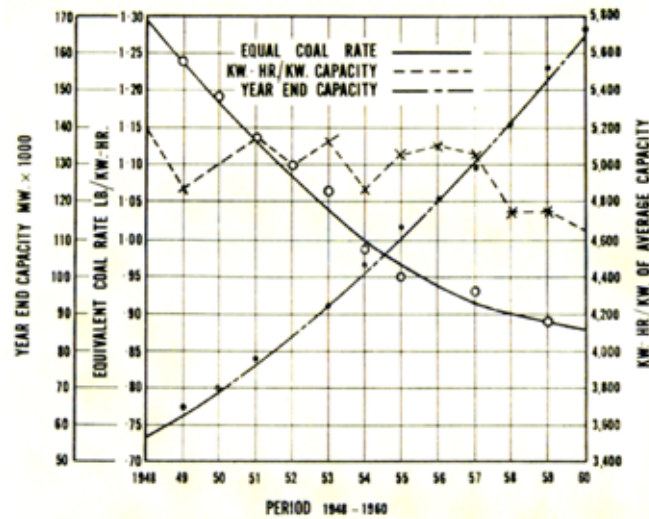


Fig. 6
Capacity-load factor-efficiency-time.

There are substantial difficulties in assessing the true rate of return on capital used to construct new generating stations because the performance of an individual station does not depend upon itself in isolation but also on the characteristics of the system and how the general load affects different generating stations. It is clear that running charges, fuel and maintenance, dominate the total cost of producing the base load unit while (Capital costs are all important in the case of 'peak load' generation (Fig. 7).

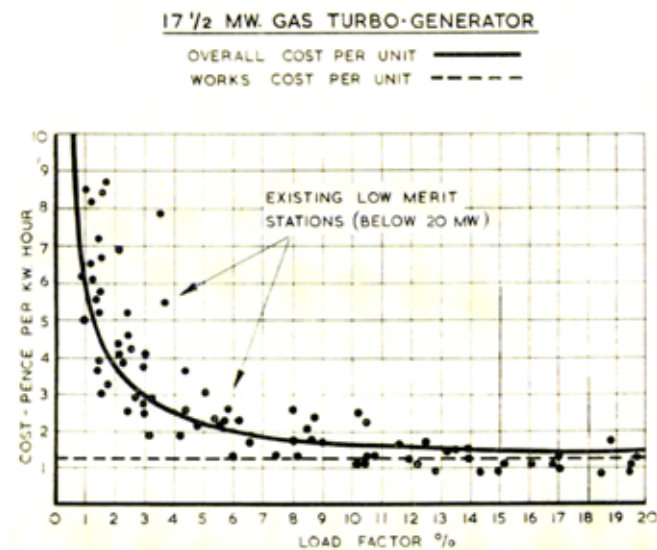


Fig. 7
Generating costs-old stations.

It has been customary to allot this peak load duty to obsolescent base load stations because the first cost has long since been written off the books. This is a fallacy in which economics are confused with accountancy tending to support the retention of obsolete equipment long after it has ceased to be an asset. For instance, a utility which writes off depreciation over twenty-five years on a straight-line basis quotes the following estimated generating costs for a modern steam power station of 2 400 MW capacity having an estimated average load factor of 41 per cent throughout its accounting life of twenty-five years, starting at 74 per cent in the first year and falling to 16 per cent in the twenty-sixth. Assuming an earnings rate of 8 per cent per annum and adjusting fuel costs to allow for the changing load factor, the estimated total unit cost for the first, eleventh, fourteenth, twenty-first and twenty-sixth year of operation are as follows: 0.588d., 0.624d., 0.675d., 0.762d. and 0.589d. (.490c, .520c, .563c, .635c and .491c), in other words, the power station is assumed to have the same earning capacity at 16 per cent as it had during its first year when operating at a load factor of 74 per cent.

An increase in consumer demand beyond the total generating capacity of a system almost always causes difficulty only at peak hours and it seems something of a paradox that long-established tradition dictates that such a condition should be corrected by augmenting the whole system by additional base load plant. In the past when the rate of technical development was such that within the space of a year or so a marked increase in overall thermal efficiency was being achieved this course was justifiable, but today when the engineering technique is becoming more stable the incremental advantage of slightly higher performance should be weighed against the financial burden of capital investment in such comparatively expensive equipment.

The power station converts one kind of energy to another more suitable for use in the factory or the home and needs to be primed with either hydraulic, thermal or nuclear power. Although a considerable amount of electricity is generated by means of water power the total potential is limited and while it is certain that atomic reactors will supply much of our needs in the future it is the fossilised fuels – coal, oil and natural gas – which will support the main burden of energy requirements for some time to come.

Steam power stations are designed to operate for long and continuous periods interrupted only by outage for maintenance once every two years. The capital cost of these large base load power stations is about £35 (R70.00) per kW and although they are efficient at high load factors the cost per unit generated rises rapidly as the utilization is reduced. The influence of load factor on the operating economics of the nuclear power station is even more pronounced than with steam plant because the fixed charges are just about double.

The economics of hydro electric undertakings are akin to nuclear plant, the first cost is approximately the same while the operating costs of energy conversion are much lower than with the classical steam unit. In order to obtain the maximum return from the investment the total annual output should just balance the natural replenishment. However, as this latter quantity is unpredictable it is necessary to carry a reserve in case of prolonged dry spells, tantamount to a reduction in utilization during normal periods.

The output of thermal plant can be controlled simply by varying the amount of fuel consumed as the supply of primary energy is in effect unlimited.

Hydro plant may be restricted in operation to an abnormally low load factor in times of drought and low reservoirs, a deficiency which usually has to be met by low merit thermal plant, alternatively, during a wet period it may well be operated for periods above its design load factor in order to make use of the water available to improve the annual economics. If this occurs when the total load on the system is substantially low, it can result in high merit thermal stations being forced to operate inefficiently on a relatively low load factor (Fig. 8). The extra units produced by hydro plant in wet years do not have the same value as the make-up units required in dry periods. There is also a practical risk in having a large proportion of low load factor hydro plant in a generating system since the nominal capacity may be found to be unable to meet peak loads under all conditions. The system is vulnerable unless firmed up by other means of generation.

SPAIN
MONTHLY LOAD FACTORS
COMBINED UNESA-INI SYSTEMS

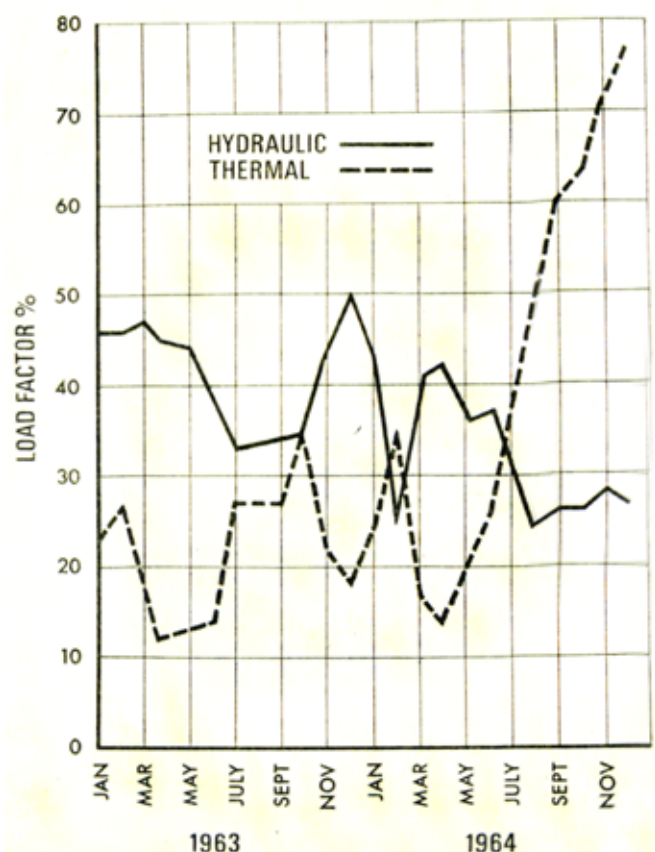


Fig. 8
Load Factor - hydraulic and thermal plant.

For instance, for the past ten years Yugoslavia has concentrated on the construction of hydro electric plant at the expense of thermal power stations and is now dependent upon a bountiful and consistent annual rainfall to ensure continuity of supplies. The long drought last year reduced reserves to a minimum necessitating a cut in the generation of electrical energy from 50 to 34 million units daily and the Government was forced to decree a reduction of 40 per cent in the consumption of electricity in the aluminium and other basic industries. It follows that there is a greater need for cheap reserve plant in association with hydro electric than any other type of generating equipment.

Where geographically practicable, reversible hydraulic plant is often used to improve the load factor on a steam electric system designed primarily for continuous duty. These pumped storage stations generate electricity during peak load periods using water from an elevated reservoir which is primed during off peak periods by the main steam plant and this water may be regarded as the equivalent of stored steam-generated energy. To be effective this type of plant requires a source of cheap power during the pumping cycle as each kWh restored to the system during peak load hours absorbs approximately $1\frac{1}{2}$ kWh of energy during off peak periods. In the more economically attractive developments the storage reservoir is between 750 to 1 000 feet above a natural lake or river which is used as the lower supply and the costs of the hydro electric and civil engineering works together with supplementary transmission costs should not exceed £60 (R120.00) per kW.

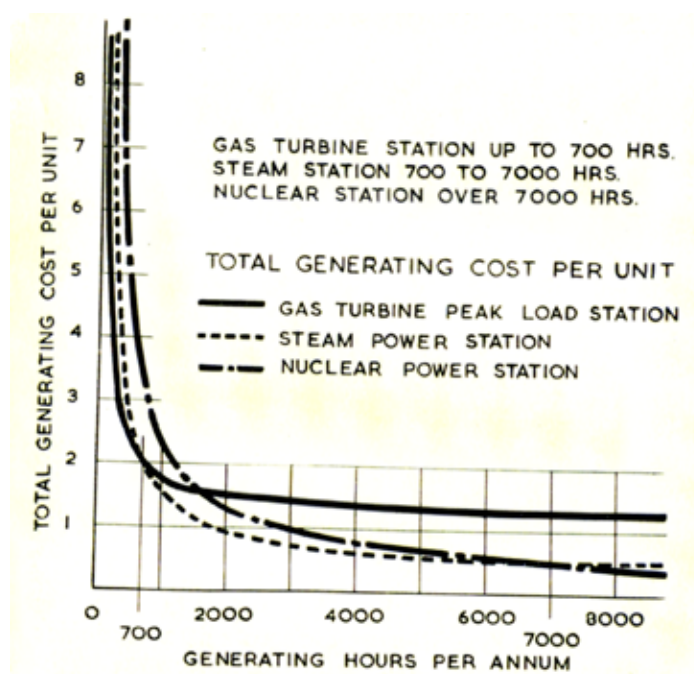


Fig. 9
Power stations, maximum economic annual utilization

Because of its low first cost and the almost instantaneous availability of full power at all times, the gas turbine power station is far more suitable for the generation of electricity at low load factors than either steam, nuclear or hydraulic plant, particularly for standby or reserve duty, or where the operating periods are intermittent and unpredictable. If the total cost per unit generated by each type of power station is plotted against utilization, the load factors for which each is most suitable are clearly discernible (Fig. 9).

If this information is referred to the capacity utilization chart we can form some idea of the proportion of the total capacity of a particular system for which the various types of power station qualify.

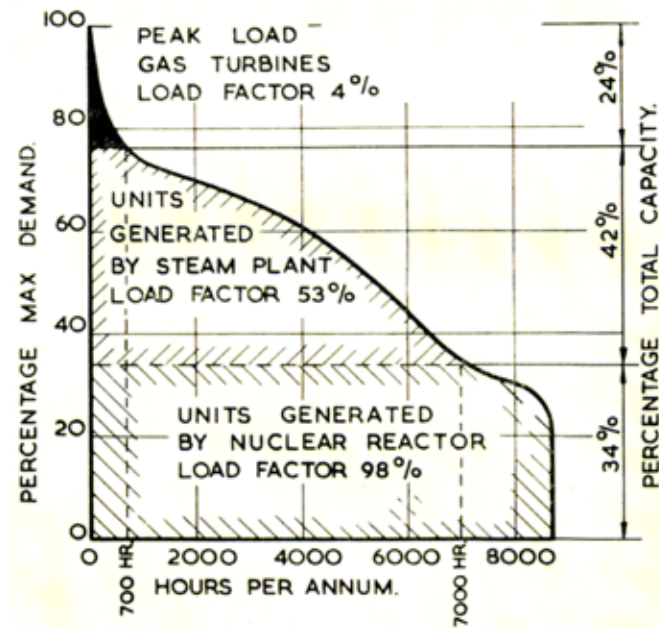


Fig. 10
Capacity utilization curve.

(To be continued...)



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Veasey's Engineering College offers study packages for self-directed study towards the Government Certification of Competency exams for Engineers.

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Study packages include theory, self-assessments, exam questions and suggested answers. Once enrolled, candidates are connected with the Veasey's Candidate network.



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All of our study packages come with 2 years individualised support offered by a Professional Certified Engineer.



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WE HAVE MORE THAN 95 YEARS OF EXPERIENCE.

MORE THAN

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GROUPS OF CANDIDATES HAVE STUDIED THROUGH VEASEY'S ENGINEERING COLLEGE

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