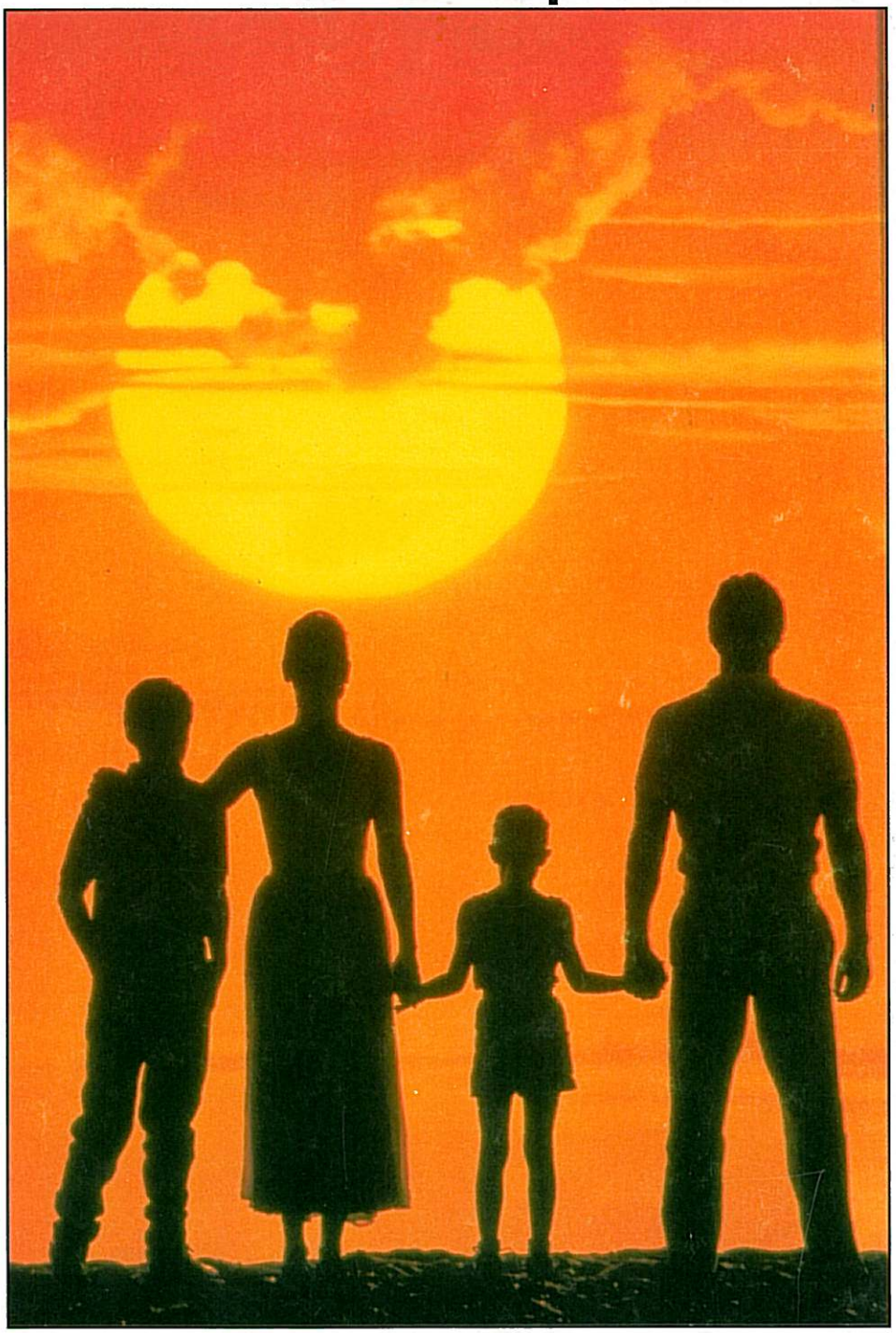
Annual Report 1993/94



Council for Nuclear Safety

MISSION

It is the mission of the Council for Nuclear Safety to safeguard persons and their property against the risk of damage from the production or exploitation of nuclear energy and associated radioactive materials in the Republic of South Africa.

STRATEGY

To accomplish this mission through

- the exercise of responsible and effective regulatory control,
- the promotion of a quality and safety culture, both within and outside its own ranks, and
- the consistent endeavour to maintain the highest level of integrity, professionalism and independence,

applying the skills of its staff in developing and implementing sound regulatory practices embodying innovative techniques, and maintaining a standard that is comparable internationally.

POLICY

The policy of the Council is:

- to address the risk of nuclear damage through the application of a quantitative risk assessment approach;
- to be cost effective in meeting its objectives and fulfilling its functions;
- to evaluate the extent to which it meets its objectives

"THE PUBLIC MUST BE PROTECTED AGAINST NUCLEAR DAMAGE"

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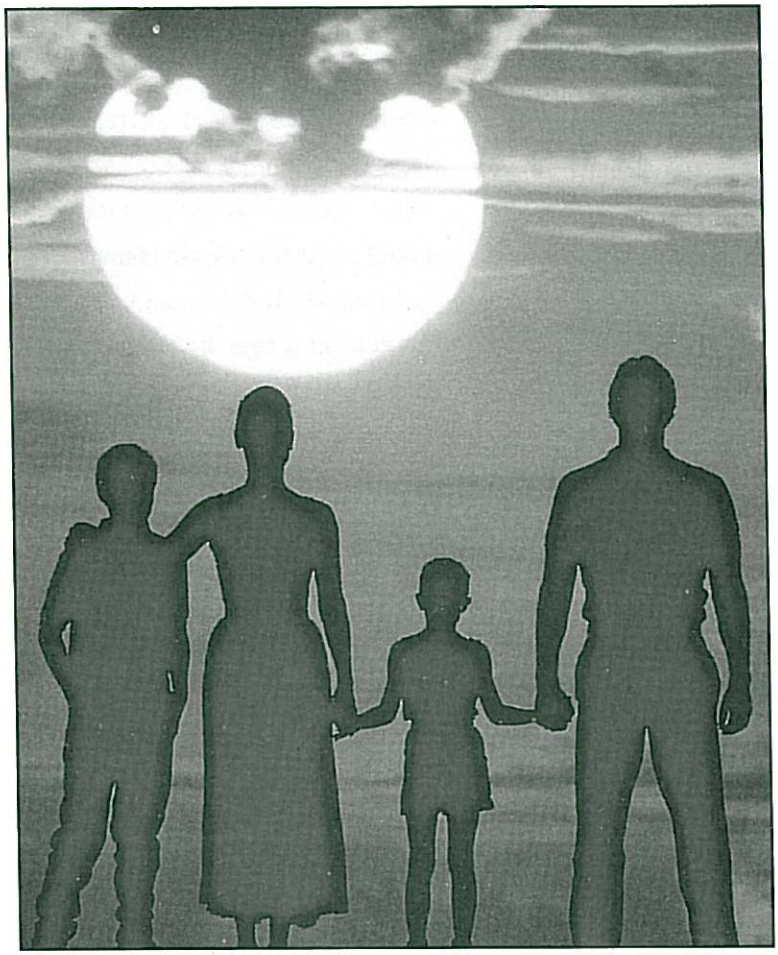


Photo: Image Bank

nuclear safety

CHAIRMAN'S STATEMENT

In almost all respects, 1994 has marked the turning point in a process of re-evaluation and reformulation of national policies and directions. South Africa's position in respect of nuclear power is among the policies which will be scutinised. Indeed this process has already been initiated in that, in February this year, the ANC held a conference in Cape Town on the future of nuclear power. Prior to this, in October 1993, the Minister had announced an investigation into the nuclear industry.

The Council for Nuclear Safety (CNS) does not see itself as a protagonist in this debate. The concern of the CNS is the safe operation of nuclear installations and other facilities that pose a risk of nuclear damage to the public. This role precludes the CNS from taking part in the political discussion either in favour of, or in opposition to, the development of nuclear power.

Nevertheless, the CNS has a role to play in the public debate, in providing accurate and independent information on safety issues to the participants.

Nuclear safety is undoubtedly the major element in the debate on nuclear power, and it is appropriate that this debate should take place in South Africa at a time when there is considerable international discussion taking place on this issue. This was precipitated by the Chernobyl accident and has received added impetus from concerns over standards of nuclear safety in certain East European countries and in the States of the former Soviet Union. The International Atomic Energy Agency is approaching the final stages of drafting a convention on nuclear safety, which has been widely supported by its member states, including South Africa.

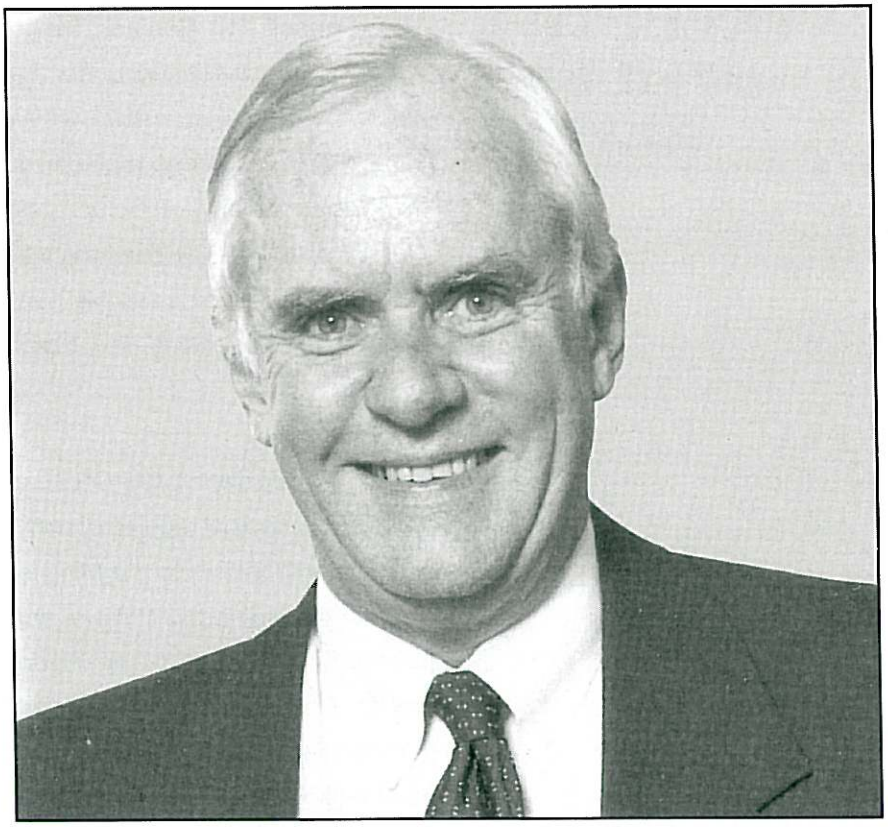
The general safety concerns cover such areas as major nuclear installations like nuclear power plants and reprocessing plants, as well as radioactive waste and the transport of nuclear material, and, in particular of high level waste, spent fuel and plutonium. In South Africa, issues involving radioactive materials occurring naturally and handled in mines and mineral processing plants are also of concern. A second element of the

"1994 HAS MARKED THE TURNING POINT IN A PROCESS OF RE-EVALUATION AND REFORMULATION"

nuclear debate is that of the relative impact of electricity generating plants on the environment. The CNS has the overall responsibility of providing an independent assessment of the actual and potential impact of the nuclear industry and its role as the regulator of this industry in regard to environmental matters, is being considered.

These anticipated developments will place additional pressure on the staff of the CNS, who have already been stretched by the demands of expanded responsibilities in the mining area and in regulation of contaminated scrap metal. On behalf of my Council I would like to express our appreciation of, and gratitude for, the dedication and commitment of the management and staff in meeting this challenge.

Finally my thanks and appreciation are due to the Minister of Mineral and Energy Affairs, the Minister of Finance, the Director-General and staff of the Department of Mineral and Energy Affairs and the members of my Council for their cooperation and support throughout the year.



Prof J.B. Martin, Chairman

the nuclear debate

EXECUTIVE OFFICER'S REVIEW

The Council for Nuclear Safety (CNS) was established under the *Nuclear Energy Act, 1982 (Act No 92 of 1982)*, which was replaced by the *Nuclear Energy Act, 1993 (Act No 131 of 1993)*. The latter was passed by Parliament on 6 October 1993 and came into operation on 1 March 1994.

Under this legislation the CNS, as the national nuclear regulatory body, which is responsible to the Minister of Mineral and Energy Affairs, is empowered to perform its regulatory functions, which include, inter alia, the licensing of nuclear facilities and other activities involving radioactive material. This, in turn, involves the enforcement of the regulatory requirements which are embodied in nuclear licence conditions and which cover aspects such as the application of quality management, the inspection of facilities, and the licensing and requalification of nuclear reactor operators. All of these are related to eventual liability for nuclear damage and are necessary to enable the CNS to fulfil its objective of safeguarding the public against nuclear damage.

In addressing the nuclear interests of the nation it is the responsibility of the State, acting on behalf of the public, to provide the means of regulatory control over activities that present a potential hazard to the general public and the relevant workforce. This requires setting up, staffing and equipping a regulatory body and taking steps to ensure that this body maintains and builds expertise in areas of potential future involvement. The cost of this should rightly be, and in South Africa has been and continues to be, borne by the State. The cost of applying the control, however, namely that involved in the technical effort directly expended by the regulator on licensing work, can justifiably be directed at those whose activities give rise to the need for control. This is the situation with the CNS, which recovers the latter-mentioned costs, constituting the major portion of its overall operating expenditure, by way of licence fees which it is authorised, under the *Nuclear Energy Act*, to levy. This approach is generally consistent with that adopted by a number of other national nuclear regulatory bodies.

AEC Research Reactor - SAFARI-1

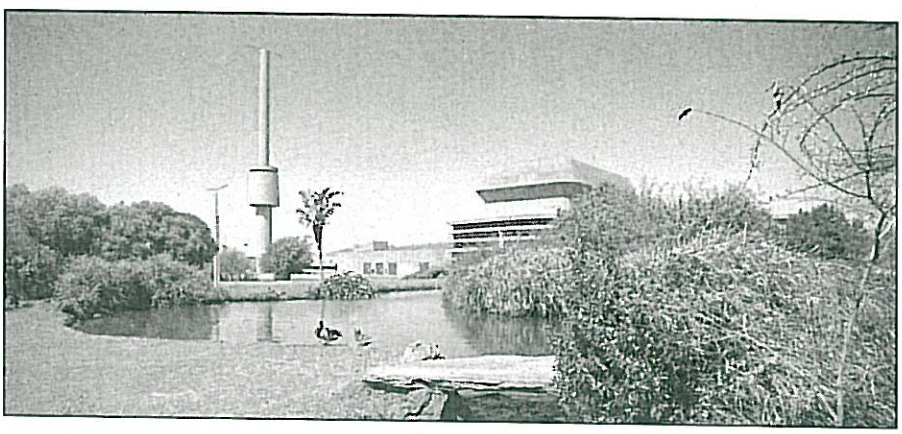


Photo: AEC

It was planned at the outset that the State's contribution, which initially constituted a high proportion of the total funding of the regulatory body and its activities, should gradually reduce and an initial target of 30 per cent was adopted. This was an informed estimate of the proportion of the budgeted expenditure of the CNS covering the cost of all but its direct licensing activities and has already been achieved.

At the time that the CNS became the independent regulatory authority, five nuclear licences had previously been granted by the AEB and the AEC. Four of these had lapsed, leaving Eskom, with Koeberg Nuclear Power Station, as the sole active licensee.

While the AEC was the regulatory body it did not license its own facilities. It was nevertheless a requirement of the *Nuclear Energy Act* that it be subjected to the same safety assessments and requirements as would have applied had the AEC been a licensee. Having relinquished its regulatory functions, the AEC itself became subject to licensing. Nuclear licences for the National

Mr B. C. Winkler, Executive Officer

independent regulation

Radioactive Waste Repository at Vaalputs and for facilities at Pelindaba and Valindaba were granted by the CNS during 1990.

Since that time, and up to 31 March 1994, nuclear licences have been granted to:

- 30 users of small quantities of radioactive material (seven of whom have since surrendered their licences),
- 22 mining and mineral processing companies (one of these licences has since been surrendered and one has expired), and
- Six scrap metal dealers and processors.

In addition,

- 15 new licence applications were received during the year from mines and processors of scrap material and metal.

A review of the activities of the CNS over the year is given later in this report.

Looking to the future, the Council's long term strategic planning includes the following:

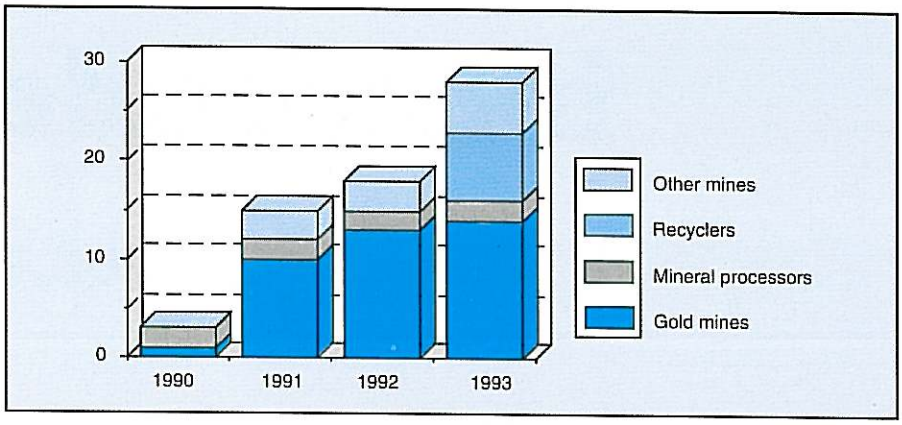
1. To ensure, within the next five years, that all those organizations and activities that fall within the ambit of the *Nuclear Energy Act* and its regulations are appropriately regulated.

2. To continue to apply the principle that the cost to the CNS of exercising regulatory control should be borne by those enterprises whose activities give rise to the need for such control, in order to minimise the cost to the taxpayer. In other words, to reduce dependency on State funding.

3. To continue the evolutionary process of nuclear regulation by revising the Statute, as necessary, to reflect changing circumstances and current trends and needs.

4. To promote coherence in the determination and application of health and safety standards to

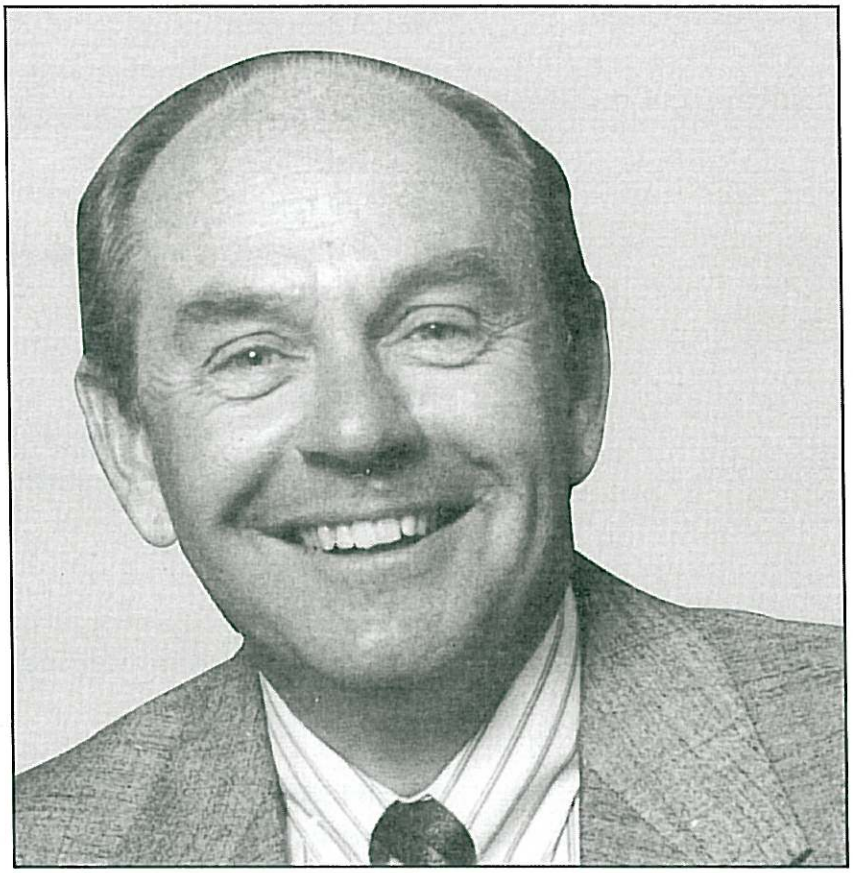
Diagram 1: Mining, mineral processing and related licensees



the benefit of the public, the workforce and man's environment.

5. To exert influence at national policy-making level in matters where the impact of nuclear regulation will need to be taken into account.

6. To expand international involvement with regard to regulatory policies and practices with a view to re-establishing South Africa's position as a regional leader.



Mr J. Leaver, General Manager

THE COUNCIL AND ITS MEETINGS

The Council's membership remained unchanged during the year and was as follows:

Chairman: Prof. J B Martin
Dean, Faculty of Engineering, University of Cape Town

Vice-chairman: Dr D Reitmann
Director, National Accelerator Centre, Foundation for Research Development

long term planning

Dr L A Dreyer
Chief Director, Land Transport Management, Department of Transport

Mr M du Toit
Deputy Director-General, Department of Regional and Land Affairs

Mr S A Gerber
Chief Director, Environment Conservation, Department of Environment Affairs

Prof. R G Harley
Head, Department of Electrical Engineering, University of Natal

Dr P R le Roux
Director, Radiation Control, Department of National Health and Population Development

Prof. A F Steyn
Head, Department of Sociology, Rand Afrikaans University

Dr P D R van Heerden
Former President, Medical Research Council

The Council held five scheduled meetings during the year. After the November meeting Council members visited Vaal Reefs mine, at the invitation of the mine management. They were given presentations by officials of the mining company on medical surveillance and the radiological protection programmes for underground and surface activities, followed by an underground visit.

Under the new Act the structure of the Council has been changed to the extent that it is no longer a requirement that its membership should include the four officers of State departments and also that the maximum number of members, which was previously fourteen, has been reduced to eight, including the Executive Officer who is an ex-officio member. The Minister is required, as a minimum, to consult certain specified individuals before appointing Council members. The present members will continue to hold office until the expiry of the period for which they were appointed, or the Minister appoints a new Council, whichever occurs first.

As required by the Reporting by Public Entities Act of 1992, the

After the July meeting of the Council Minister G.S. Bartlett, and Dr. P. J. Hugo, Director-General, of the Department of Mineral and Energy Affairs, attended a luncheon at the CNS offices.

Council has established an audit committee with four members, including two Council members, one member from the private sector and one member of the CNS staff.

STRUCTURE AND STAFFING

Whilst the organisational structure of the CNS remained unchanged throughout the year, it has become clear that some fundamental changes will be required if it is to continue to apply its resources in the most effective manner, in order to meet its objectives. Development of the necessary changes is well advanced and they will be introduced early in the coming financial year.

Two staff members resigned during the year and two new members were appointed, leaving the total complement unchanged at seventy four.

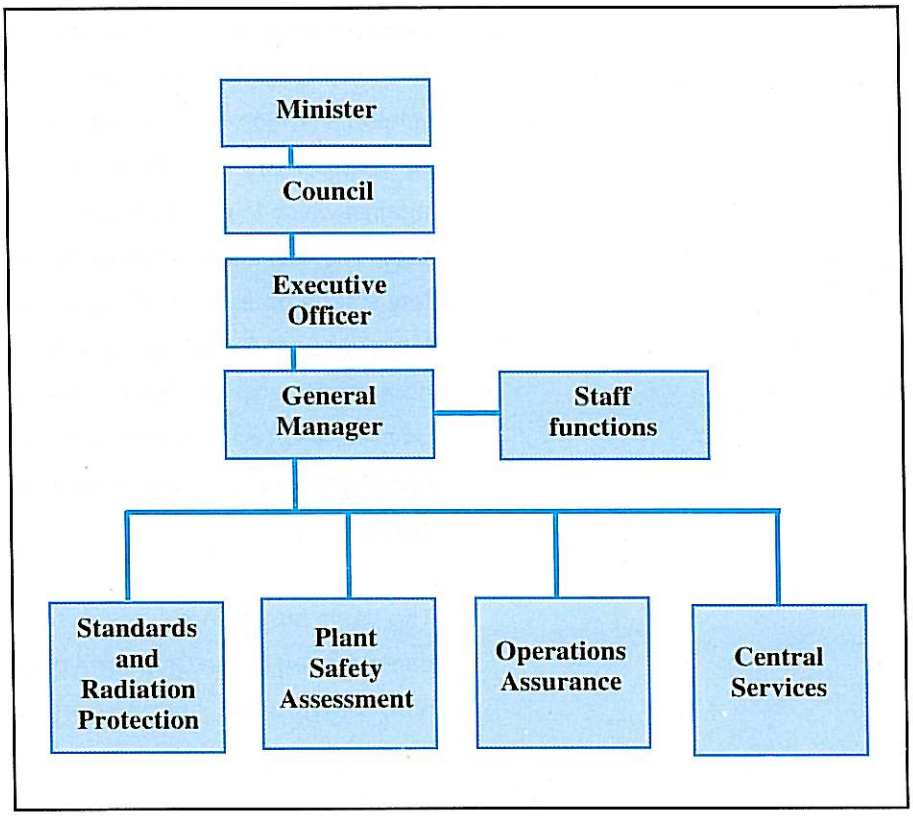


Diagram 2: CNS organisational structure

SAFETY STANDARDS

Fundamental to the mission of the CNS, namely that of ensuring that

persons are safeguarded against the hazards of radiation from nuclear and related activities, is the maintenance of appropriate safety standards against which to assess those activities. These are the fundamental safety standards against which quantitative assessments of nuclear risk are compared, and the standards of practice which will ensure operational compliance with the determined risk criteria.

The basis on which the safety standards applied by the CNS were originally established remains valid, namely that –

- nuclear risks should not add significantly to the total risk to which society is exposed,
- the risks should compare favourably with risks associated with other industries, and
- allowance should be made for an observed trend towards increased safety standards as time passes – that is to say that nuclear facilities or activities should be licensed on the basis that the risks they impose will be acceptable over their lifetimes.

With attention being focused increasingly on the longer term effects of waste disposal and the decommissioning and closure of licensed activities, consideration has been given to the fundamental safety principles that should attend these activities. Principles which are widely accepted internationally in this regard demand that the degree of protection afforded to future generations, from activities conducted today, should be no less than that afforded to the present generation, and that future generations should not be unduly burdened with the costs of providing this level of safety. Over the past year the CNS has continued to contribute to the establishment of international consensus on these matters, particularly in relation to mining and minerals processing activities, and has continued to address national requirements. The impact of the application of these principles has received considerable attention throughout the year and will continue to do so for some time to come.

The CNS has played an active role in the revision of the IAEA's Basic Safety Standards to incorporate the

"PROTECTION AFFORDED TO FUTURE GENERATIONS SHOULD BE NO LESS THAN THAT AFFORDED TO THE PRESENT GENERATION "

1990 recommendations of the International Commission on Radiological Protection (ICRP). In this it has been closely involved with the International Atomic Energy Agency (IAEA) and its co-sponsors. The latter include the World Health Organization, the International Labour Office, the Food and Agriculture Organization of the United Nations, the Pan-American Health Organization and the Nuclear Energy Agency of the OECD. It is intended that these revised Standards be finalised and presented to the governing bodies of the sponsoring agencies for approval during 1994.

The CNS generally endorses the contents of the Basic Safety Standards but remains concerned about the principles that should be adopted in respect of control over exposure to radiation from natural sources, such as that associated with mining and minerals processing activities. The CNS is of the opinion that the international agencies should give further consideration to this aspect, as well as to the issue of relaxing radiation dose limits on the basis of prevailing operational circumstances.

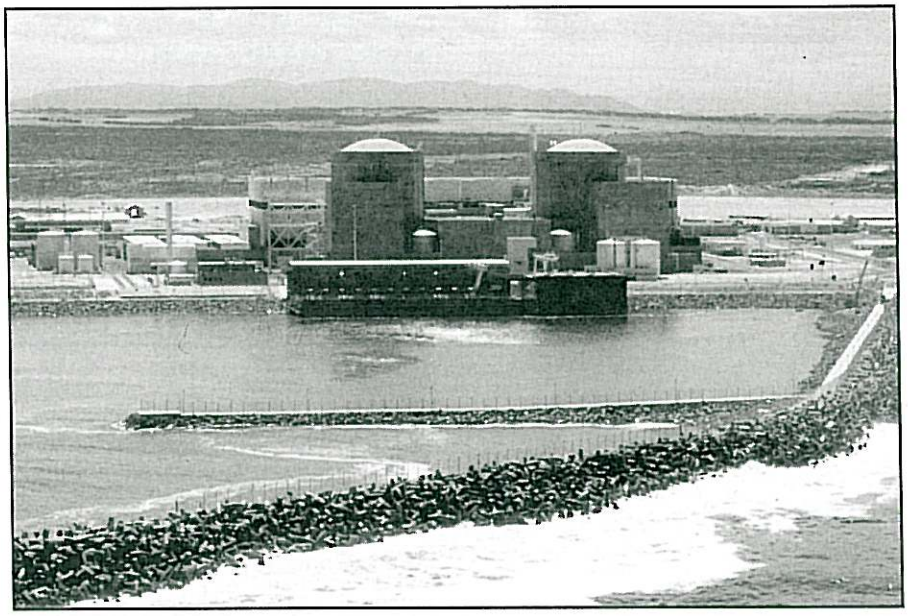


Photo: Eskom

Koeberg Nuclear Power Station

radiation protection

DETERMINATION OF EXCLUSION AND EXEMPTION LEVELS

In revising the *Nuclear Energy Act*, principles have been incorporated which allow for certain activities involving radioactive material to be exempted from licensing, at the discretion of the CNS, where assessment of the associated risks has shown that these are acceptable. In addition, radioactivity levels below which activities are excluded from the provisions of the legislation are identified by notice in the *Government Gazette*.

This is consistent with consideration that is being given in various countries to levels for exemption and exclusion, and the IAEA has included considerations in this regard in the Basic Safety Standards. The levels are based on the exemption principles recommended by the ICRP, which suggest that an activity which involves radioactive material and gives rise to a dose in the region of 10 μSv per annum should be exempted. This relates to an annual mortality risk in the region of 10^{-6}.

The corresponding levels of specific radioactivity in bulk materials, which have been determined by various institutions, are dependent upon the nature of the exposure scenarios considered, and generally relate to limited quantities of material of up to one cubic metre in volume.

Because of this dependency, no absolute level of specific radioactivity in materials in which exemption is allowed can be derived in the absence of information on the intended use of the material. Therefore a discretionary band of specific radioactivity has been defined and materials falling within this category are considered for exemption on a case-by-case basis, depending upon their intended use.

KOEBERG NUCLEAR POWER STATION

CONTROL OF EFFLUENT DISCHARGE AND PUBLIC EXPOSURE

Following the establishment of a revised model for migration of radio-

"COST SAVINGS HAVE BEEN ACHIEVED WITHOUT COMPROMISING PUBLIC SAFETY"

activity within the Koeberg plant systems, revisions were made to the Annual Authorized Discharge Quantities (AADQs) specified by the CNS for Koeberg Nuclear Power Station. The Council gave approval for these to be implemented during 1993.

A complementary programme was also established in order to verify assumptions regarding operational parameters that have been used to determine the revised discharge figures. The new activity migration model developed by the CNS has allowed more operational flexibility in the treatment of liquid and gaseous effluent, and has led to significant cost savings being achieved in this regard without compromising public safety.

The discharge of gaseous and liquid radioactive effluent to the environment resulted in a total annual effective dose of 0,312 µSv to the most highly exposed member of the public, as calculated using the revised dose conversion factors. Approximately 60% of this dose resulted from radioactivity in liquid effluent and 40% from gaseous effluent. Thus the an-

Test to determine the dilution of liquid effluent discharged from Koeberg power station

radioactivity migration

nual dose as a result of radioactive effluent discharges from Koeberg for 1993 was approximately 0,12 % of the dose limit.

ENVIRONMENTAL SURVEILLANCE AROUND KOEBERG

In accordance with the licensing requirements, a routine programme of analysis is undertaken by Eskom at Koeberg.

The CNS confirms the results of this programme by selecting duplicate samples, and analysis of such samples of environmental media from Koeberg has verified that the controls on radioactive effluent discharge are satisfactory.

CONTROL OF OCCUPATIONAL EXPOSURE TO RADIATION

Three reactor outages took place during the year. Two of these were major outages for refuelling and maintenance on units 1 and 2. Collective doses for these outages are given in Table 1.

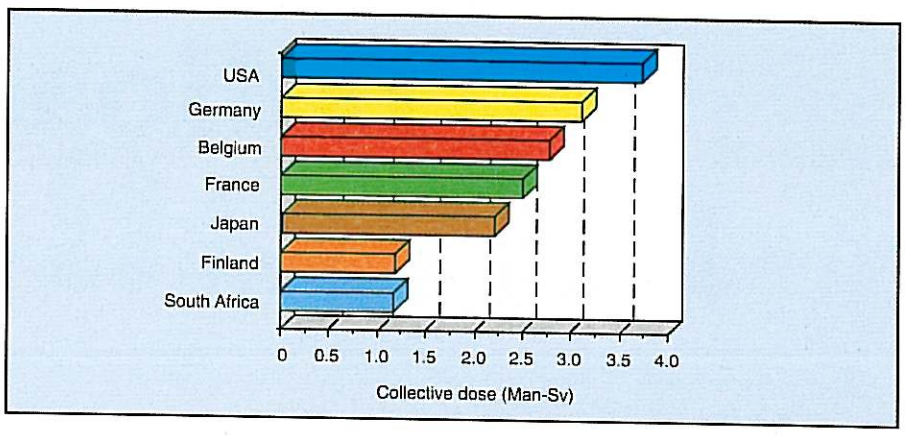
As a measure of the effectiveness of the operational radiation protection programme, Koeberg continues to perform as one of the stations with the lowest collective dose values, accrued during maintenance and refuelling activities, in the world.

The recommendations of the ICRP regarding the limitation of dose to the occupationally exposed workforce led to the joint consideration by the CNS and Eskom of, inter alia, the reduction of the annual individual dose limit from 50 mSv to 20 mSv. The impact of this fundamental change on the operational radiation protection programme was investigated and most of the necessary changes were implemented.

OPERATIONS ASSURANCE AND PLANT SAFETY ASSESSMENT

Safety culture – an essential aspect of nuclear regulatory work – can be

Diagram 3: Annual average collective dose per reactor by country (1986 - 1991)



defined as that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance. A presentation by the IAEA on the identification and analysis of safety culture deficiencies was attended by members of the Operations Assurance Department during the course of the year.

OPERATION	TOTAL DOSE (rounded values)
Unit 1, major outage	1,22 man-Sv
Unit 2, major outage	1,32 man-Sv
Unit 1, minor outage	0,03 man-Sv
Total outage dose	2,57 man-Sv
Normal operation dose	0,51 man-Sv
Total collective dose for the year	3,08 man-Sv

Table 1 : Three reactor outages took place at Koeberg during the year. The table reflects collective doses for these outages and for normal operations.

Events of nuclear safety significance which occur in South Africa are reported to the IAEA Incident Reporting System (IRS) by the CNS, as the national communications link. The IAEA database contains nearly 1 500 such events, eight of which have been reported by South Africa.

Through contact with the US National Coordinator, the CNS also has access to the Nuclear Energy Agency of the Organization for Economic Co-operation and Development (NEA/OECD) IRS database, containing over two thousand safety significant events. The method of licensing and the implementation of the licensing process adopted by the CNS lend

safety culture

themselves to the analysis of events, and events which have occurred in South Africa fit into the world pattern of "benefiting from experience".

A computer database was established to record all compliance inspections carried out by the CNS. Regular inspections are automatically triggered by the system to ensure that no required inspections are overlooked.

Three new reactor operator licences were granted during the year and these were presented to the successful candidates by the General Manager, at a function hosted by the CNS in November 1993.

The licensing process involves assurance of compliance with licence conditions, through the continuous monitoring of day-to-day issues arising from various nuclear activities and installations – such as safety submissions, licence change requests, occurrence reports and modifications. In addition, continuing proactive work on safety support activities is required, either to quantify relevant safety margins or to explore the impact of reported worldwide nuclear safety experience on the design and/or operation of licensees' installations.

Much of this work has been undertaken by the Plant Safety Assessment Department and the Operations Assurance Department.

Safety studies were carried out during the year to assess the impact of the introduction of fuel at a slightly higher enrichment level (3,9%) into the reactor core. The primary effect of using this new fuel will be to extend both the burn-up period (from 12 to 18 months) and the life of the reactor pressure vessel. These continuing core behaviour studies were carried out in conjunction with Eskom and Framatome.

An invitation was received, during the year, from the US Nuclear Regulatory Commission, to become a member of their thermal hydraulic Code Applications and Maintenance Programme. This is the only means whereby the CNS can maintain an up-to-date awareness of developments and applications of the use of

The CNS site office staff at Koeberg are responsible for regulatory inspection activities and for licensing examinations for control room operators

the associated RELAP-5 code for regulatory purposes. It is expected that a formal agreement will be completed during the coming year.

In the two-yearly Eskom audit of civil structures at the Koeberg plant, in which the CNS participated, no significant deficiencies in nuclear safety related structures were found.

A system of plant operating reports, which has been developed with the cooperation of Eskom's programmers, enables specific raw plant data to be extracted and transferred electronically via the ACCESS program. The CNS has established a system for continual monitoring of plant performance, using relevant data from some 3 000 plant components. This capability provides assurance that "risk-significant" components are being maintained to the same level of reliability as was assumed in the probabilistic risk assessment (PRA), which forms the basis of licensability.

In order to study the effect of environmentally assisted cracking of reactor pressure vessel steels, Eskom and the CNS have established a collabo-

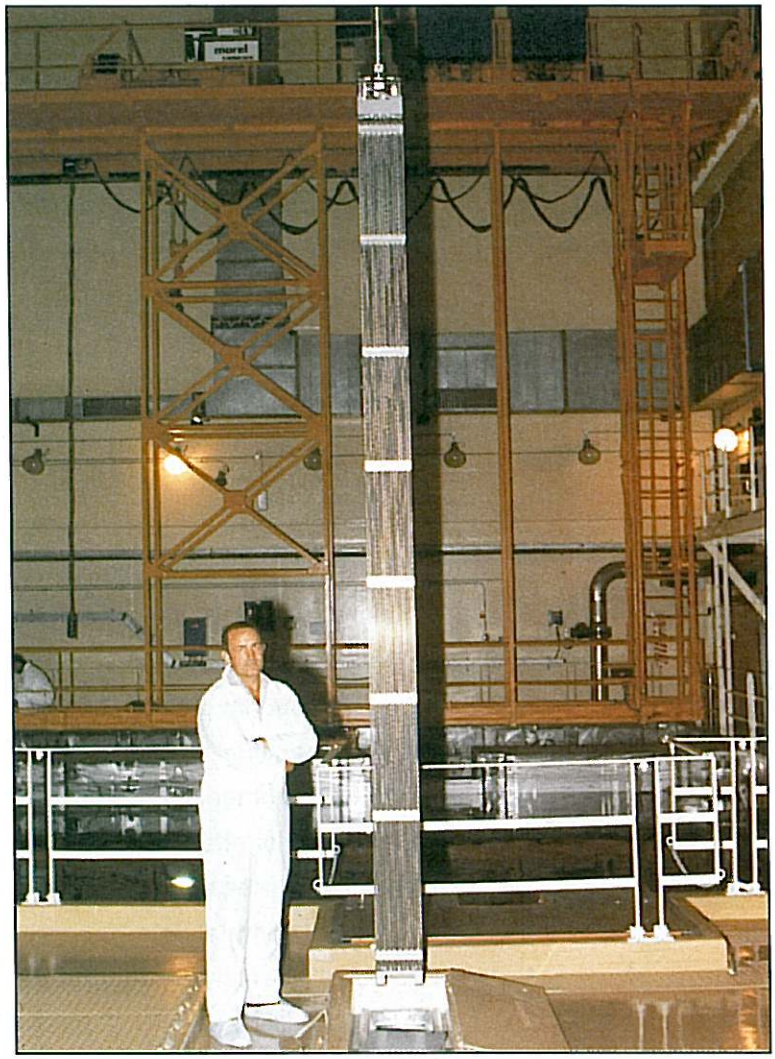


Photo: Eskom

A Koeberg reactor fuel assembly

performance monitoring

collaborative programme for investigating the metallurgical characteristics of, initially, remnant material from the Koeberg pressure vessels and certain primary circuit components. This will, inter alia, complement the mandatory reactor vessel surveillance programme.

SPENT FUEL STORAGE

The spent fuel storage facility at Koeberg has a finite capacity which makes it necessary to consider an alternative interim storage arrangement for spent fuel. The chosen option is cask storage and a considerable amount of effort has been devoted to the assessment of Eskom's spent fuel interim storage proposal and complementary safety assessment of the cask store. The final site for interim storage has yet to be decided.

NUCLEAR EMERGENCY PLANNING FOR KOEBERG

The emergency planning arrangements for Koeberg are very extensive, involving numerous organizations and complex processes to identify rapidly, and assess, the potential consequences of any accident or abnormal operating state.

In order to ensure that the plan remains viable at all times, various assurance mechanisms are required by the CNS, including testing, auditing and exercising. These assurance activities naturally lead to the identification of issues to be addressed which range from relatively minor to those with more significant implications. Corrective actions to address these issues also range from the relatively simple to the more involved, and their timely and systematic resolution is important. Based on the results of previous emergency exercises conducted by the CNS, a computer based corrective action programme was implemented by Eskom, during the year, to ensure that deficiencies identified by exercises are listed and addressed in the most constructive and timely manner.

The Koeberg internal quality assurance programme for emergency planning has been closely monitored

"ALL ASPECTS OF EMERGENCY PLANNING ARE SUBJECT TO DETAILED REVIEW THROUGHOUT THE YEAR"

by the CNS and found to be effective in complementing this process.

In view of the number of parties involved in emergency planning it is vital that adequate liaison be maintained at all times. To facilitate such liaison the CNS maintains the Koeberg Emergency Planning Liaison Committee, with representation from the various local authorities and other interested parties in the Koeberg environs. The committee, chaired by the CNS, met three times during the year and provided a forum for the interested parties to address all aspects of the emergency planning arrangements for Koeberg.

In addition to liaison with the off-site authorities, all aspects of emergency planning have been subject to detailed review with Koeberg emergency planning staff throughout the year.

In line with developments in other countries, the CNS has been active in addressing plans for the late phase of emergencies. In this phase, which would extend for a period of months to years following the unlikely event

Photo: Eskom

Concrete containers for the disposal of intermediate level radioactive waste

emergency planning

of a major accident affecting the wider public, it is important that the necessary capabilities are able to be deployed in the application of remedial measures.

The planning involves:

- identification of the resources that would be necessary;
- identification of the organizations that would be involved;
- establishing strategies for decision making and implementation;
- training and exercising.

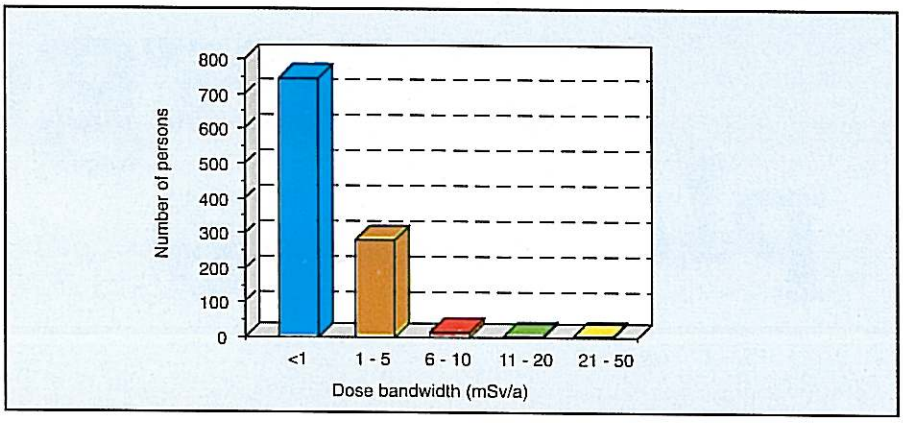
The proposal that the CNS chair the late phase emergency organization has been generally accepted by all parties concerned.

POPULATION DEVELOPMENT AROUND KOEBERG

The acceptability of the risk imposed by Koeberg was based upon safety criteria which include consideration of both the total number and the distribution of the population around Koeberg. In order to ensure that these criteria are not compromised, control over development in the Koeberg environs has been necessary. The provisions for the exercise of this control were agreed with the relevant local authorities and incor porated into the 1981 Atlantis Guide Plan, and are based on the principles that –

- at the start of a plant's operating life, mechanisms shall exist which will prevent a situation arising in which, because of uncontrolled development, the safety features designed into the plant will no longer be adequate for ensuring that the safety criteria laid down are not exceeded. (with the consequent imposition of an unacceptable risk to the public), and
- the population distribution in the immediate vicinity of the plant shall be controlled to ensure that a viable emergency plan can be formulated and maintained with time. This would involve, inter alia, effective communication, shelter, iodine prophylaxis and evacuation, which would have to be initiated in the event of an accident.

Diagram 4: Numbers of occupationally exposed AEC personnel in various annual dose bandwidths for 1993



ATOMIC ENERGY CORPORATION

CONTROL OF EFFLUENT DISCHARGE AND PUBLIC EXPOSURE

The operation of AEC facilities at Pelindaba results in the discharge of various radioactive gaseous and liquid effluent streams to the environment. The doses to the most highly exposed member of the public, as a result of these discharges during 1993, were estimated to be 19 µSv and 0,01 µSv, respectively, for the gaseous and liquid effluent streams. The total annual dose was less than 10% of the annual dose limit for the site.

Site	Annual equivalent dose range (mSv)						No. persons exposed
	<1	1 - 5	6 -10	11 - 20	21 - 50	>50	
Pelindaba East	250	131	4	1	0	0	386
Pelindaba West	386	28	9	5	2	0	430
BEVA	109	120	1	1	1	0	232
Total	745	279	14	7	3	0	1 048

Table 2: The control of occupational exposure to radiation within the facilities of the AEC is exercised through the operational radiation protection programme. The total number of occupationally exposed persons for 1993 was 1 048, for whom the collective dose was 1,049 man-Sv.

CONTROL OF OCCUPATIONAL EXPOSURE TO RADIATION

The control of occupational exposure to radiation within the facilities of the AEC is exercised through the operational radiation protection programme, which has been applied for

many years. In terms of the regulatory requirement, however, it has been necessary to implement a schedule for the stratification of the programme in a manner which is consistent with the requirements of the licence. During 1993 a considerable effort was made to achieve this objective and progress has been made with all facets of the operational radiation protection programme in this regard.

The total number of occupationally exposed persons in 1993 was 1048, for whom the collective equivalent dose was 1,049 man-Sv which is acceptably low. The distribution of annual equivalent dose in various dose bandwidths is tabulated in Table 2 and presented graphically in Diagram 4.

PLANT SAFETY ASSESSMENT

After review and acceptance of the relevant safety assessments, the CNS authorised licence changes and activities in respect of facilities at the Pelindaba site, as follows:

- the use of UO_3 as feed material for the uranium conversion plant instead of U_3O_8 for which the plant was originally designed;
- production of ^{99}Mo in the Hot Cell Complex by extraction from irradiated target plates;
- approval of a number of licence change requests as well as modifications to the uranium enrichment plant and its associated facilities.

The safety assessment for a pilot uranium enrichment facility, using the molecular laser isotope separation (MLIS) process, reached the closing stages of review by the CNS. It is expected that authorisation for the AEC to commission and operate this plant will be given during 1994.

VAALPUTS RADIOACTIVE WASTE REPOSITORY

During the period 1 January to 31 December 1993 the National Radioactive Waste Repository at Vaalputs received the following wastes from

During July 1993, senior consultants from the mining industry were taken to visit the National Radioactive Waste Repository at Vaalputs

its one client, namely Koeberg nuclear power station:

- 384 concrete containers (total activity = 9,OE+03 GBq)
- 465 metal drums (total activity = 4,65E+01 GBq)

There were no deviations from the requirements of the nuclear licence.

TRANSPORT OF RADIOACTIVE MATERIAL

In its capacity as National Competent Authority for transport of radioactive material, the CNS issued the following Certificates of Approval (or renewal) and shipment approvals in terms of the IAEA-regulations:

- The Framatome RCC-3 shipping container for new fuel assemblies, to Eskom.
- The General Electric 21PF-1 container for the conveyance of enriched UF_6 to the AEC.
- The Nuclear Containers Inc., NCI-21PF-1 container for the conveyance of enriched UF_6 to the AEC.

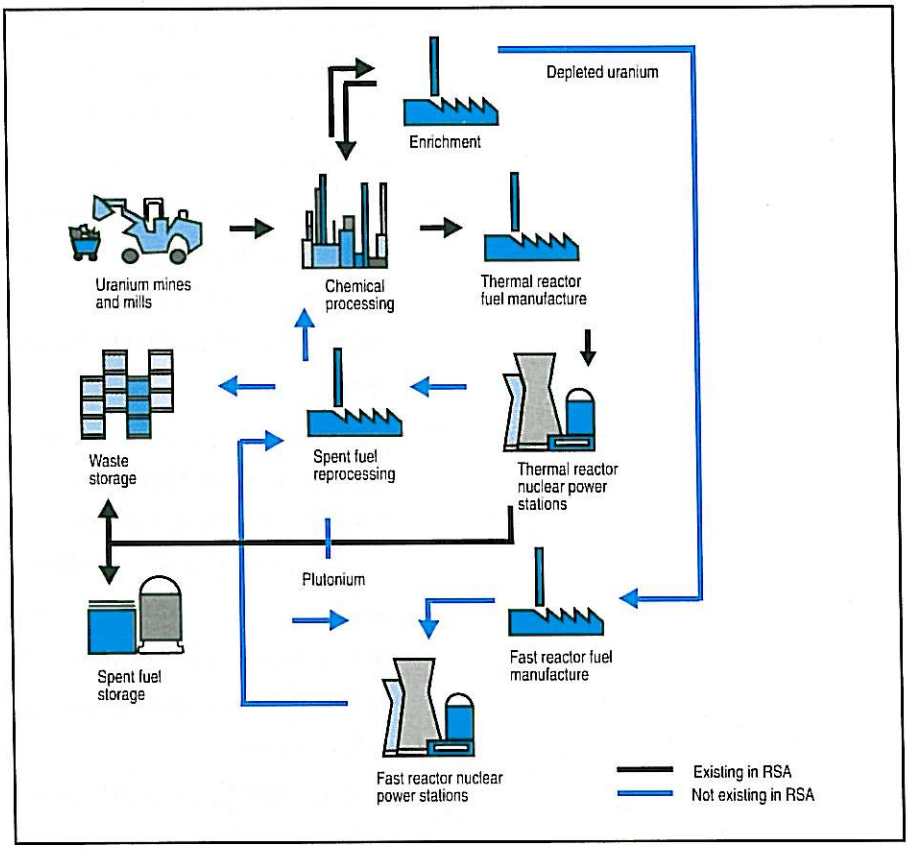


Diagram 5: The Nuclear Fuel Cycle

waste disposal

- Renewal of the Approval Certificate for a further period of five years for a type-B(M) transport container, issued to the AEC.
- Conveyance by the AEC under special arrangement of a redundant cobalt-60 teletherapy source from Mauritius to South Africa.
- Conveyance by the AEC under special arrangement of a redundant cobalt-60 teletherapy source from Congo to South Africa.
- Conveyance by ESKOM of spent fuel pins from Koeberg to Pelindaba.
- Conveyance by the AEC of enriched uranium to overseas markets.

LICENSED USERS OF SMALL QUANTITIES OF RADIOACTIVE MATERIAL

During the year under review one new licence was granted, bringing the total number of users of small quantities of radioactive material to twenty-three.

CNS LABORATORY FOR RADIOCHEMICAL ANALYSIS

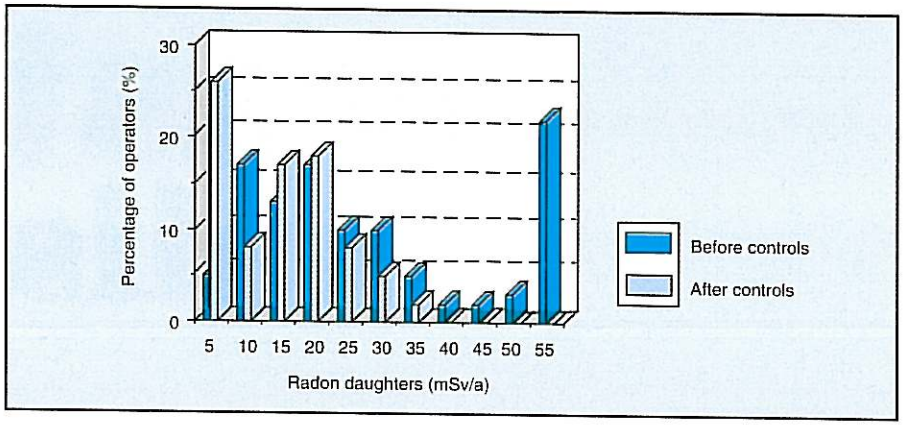
In view of the increasing demands for analyses in connection with mining and industrial operations, further development of the analytical capabilities of the laboratory has become necessary. During 1993 a multi-input multichannel analyser was acquired.

Approximately 230 samples have been analyzed by gamma spectrometry for natural radioactivity in connection with the CNS investigation into the contamination of scrap metal. A further 100 samples were analyzed in connection with the environmental monitoring verification programme at Koeberg.

MINING AND MINERALS PROCESSING

Considerable progress has been made in licensing mining and minerals processing facilities. At the end of the year under review, twenty licensing projects were in hand in respect of

Diagram 6: Distribution of radon daughter readings in a particular underground ventilation district, before and after the implementation of engineering controls



various mining and minerals processing activities, as well as six associated with recyclers of scrap materials arising from the industry.

At present the licensing work in this area is essentially retrospective in' nature. It requires assessment, in a scheduled manner, of radiation hazards to the workforce – both underground and in surface plants – and also of potential hazards to the public. The latter hazards arise from effluent discharge, waste disposal practices and re-use of materials. Once the necessary detailed licensing procedures have been finally established, the appropriate controls will be applied prospectively to licensees.

Radon daughters (mSv/a)	0 - 50	> 50
Percentage of workers exposed - previous	43%	57 %
Percentage of workers exposed - present	100 %	0 %

Radon daughters (mSv/a)	High	Average
Previous level	259	56
Present level	50	25

Table 3: Improved control measures have effectively reduced underground radon levels and exposure of persons

OCCUPATIONAL EXPOSURE

Progress was made in the determination of hazards to the workforce involved in both surface and underground operations. Cost-effective methodologies for the estimation of doses to the large number of underground workers who are subject to

occupational exposure

exposure to varying levels of radon gas have been investigated, with a view to establishing radiation protection programmes. In all cases where exposures in excess of prevailing annual limits were estimated during the hazard assessment phases, immediate steps were taken to reduce such exposures. These have included ventilation changes underground and procedural controls in the case of surface operations. (Diagram 4 and Table 3)

Control measures which were implemented during maintenance work on, and the demolition of, pyrite burning sulphuric acid plants and uranium plants have resulted in the achievement of a significant reduction of exposures to workers involved in these activities. (Diagram 7)

ENVIRONMENTAL ASSESSMENT

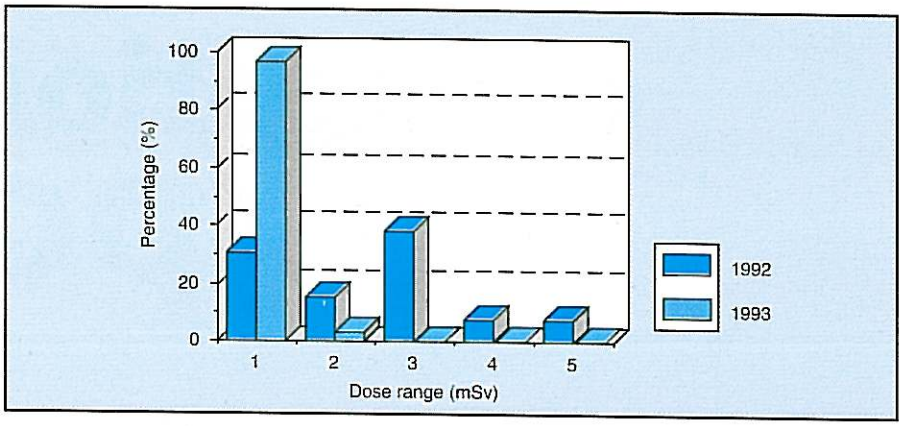
The process of identifying all pathways for public exposure commenced during the year, as did the development of methodologies for conducting the assessments and validating the results of such assessments.

CONTAMINATED SCRAP MATERIAL

In the early part of the year the disposal of contaminated materials arising from demolition activities began to become an issue. This was highlighted by the rejection, on receipt, of a consignment of contaminated scrap stainless steel which had been exported to the United Kingdom and its return to its source in South Africa. This had resulted in the importing company having severe restrictions imposed on it by the United Kingdom authorities and led to an extensive investigation being carried out by the CNS.

The investigation revealed that the source of this particular material was but one of a number of mining and minerals processing activities which were generating contaminated scrap material and that such material had, in turn, been distributed into the public domain in an uncontrolled fashion for years. This practice had led to

Diagram 7: Acid plant maintenance shutdown – percentage of workers exposed to more than 1 mSv

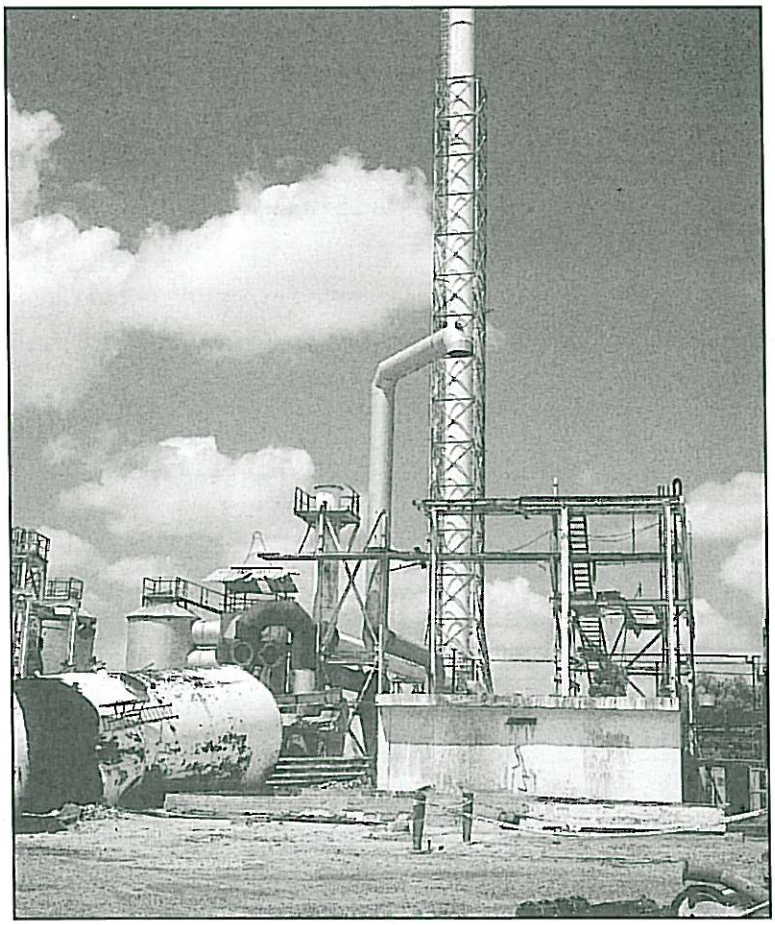


to the contamination of numerous sites off mine properties and these have been the subject of a further major investigation.

Structures were established to co-ordinate the various investigations and necessary remedial measures. An Executive Coordinating Group was formed, with representation from the mining industry and the CNS. The industry also established a Task Force, and a Rehabilitation Unit was set up within the CNS.

The mining companies provided information on all scrap distribution pathways, and surveys were carried out on all potentially contaminated properties. The extent of contamination at the affected properties was determined and areas were suitably delineated, with certain restrictions being imposed on operators.

Of the 105 sites which were surveyed in detail, eight in Phalaborwa and 30 in the PWV and Free State Goldfields regions were found to be in need of decontamination. On 15 there were contaminated items which required removal in a controlled manner.



A sulphuric acid plant in the process of being demolished

radioactive contamination

The contaminated sites in the Phalaborwa area were all rehabilitated by the Palabora Mining Company and contaminated material was transferred to the site of that company.

With regard to sites elsewhere in the Republic, the mining industry made available a sum of five million rands to conduct these investigations and to provide for short term control measures.

Procedures were established for segregation of the more contaminated items of scrap in accordance with lists of prohibited items, washing of the remaining material and transporting this material off the site in accordance with the required transport regulations. Six companies involved in re-cycling operations were licensed and procedures were implemented to ensure that the materials were handled safely. In addition, the Atomic Energy Corporation was engaged to investigate the radiological impact of the controlled re-cycling process with a view to validating the adequacy of controls and to investigate the feasibility of re-cycling the materials which were currently being segregated as prohibited items.

Apart from CNS staff, instrumentation and facilities, additional resources were obtained nationally from Eskom, the AEC and private companies. Consultants from the United Kingdom were also employed.

MINE CLOSURE AND RESIDUALLY CONTAMINATED LAND

Further consideration was given to the matter of mine closure and the degree of rehabilitation and institutional control that will be necessary to limit the residual radiation hazards to the public.

The CNS has kept closely in touch with international developments in this regard and it is clear that this is a matter that will take several years to resolve.

Criteria for the clearance of land previously used for mining activities were further studied in order to formulate a protocol for the determination of re-

Western Deep Levels Gold mine; one of twenty mining activities licensed by the CNS

Photo: Anglo American Corp

sidual levels of contamination of such land.

TRAINING

During the investigation into the release, into the public domain, of contaminated materials from mining and minerals processing facilities, it became evident that the limited number of personnel in the industry who were suitably qualified in the sphere of radiation protection was a matter to be addressed urgently. CNS staff have subsequently played a pivotal role in the development of modules which will eventually form a training course for radiation protection officers. By the end of the year under review 73 persons had successfully completed the first module of the course.

Mr H.G.F.S. Parish, Manager: Operations Assurance (second from left) was a member of the IAEA's ASSET mission to Dukovany nuclear power station in the Czech Republic

PARTICIPATION IN MEETINGS AND CONFERENCES

Over the past two years members of the CNS staff have participated in work groups – within a programme

mine closure

established by the Department of Environment Affairs – to consider the environmentally safe management of dangerous materials. The purpose of this is to coordinate the activities of those organizations responsible for the handling and transportation of such materials, for regulatory control, and for emergency action in the case of accidents. Particular emphasis is placed on communications. The objective is to ensure not only that appropriate packaging, handling and transport procedures are adhered to but also that all parties who may be involved in the case of an accident are aware of the facilities available and of the proper actions to be taken.

It is essential that the CNS technical staff keep abreast of developments in the nuclear industry and, in particular, in the fields of operational safety and regulatory control, and relevant conferences and seminars are regularly attended.

During the year twelve members of staff attended conferences, training courses and technical meetings in Austria, Germany, Spain, Israel, France, the United Kingdom and the USA. Topics addressed included:

- probabilistic safety assessment,
- accident sequence modelling,
- material degradation,
- operational safety,
- radiation protection,
- reactor physics, and
- incident reporting.

In addition, there has been a noticeable, and very pleasing, increase in communication and technical information exchange with the IAEA and various member states. This has been, and should continue to be of considerable benefit to the CNS as a nuclear regulator.

The following staff members were invited to participate in specialist missions and technical committee meetings:

- Mr P E Metcalf, Manager: Standards and Radiation Protection Department was invited to participate in discussions on the revision of the IAEA's Basic Safety Standards in Vienna, and was Chairman of the committee on radioactive waste.

"IT IS ESSENTIAL THAT THE CNS TECHNICAL STAFF KEEP ABREAST OF DEVELOPMENTS IN THE NUCLEAR INDUSTRY"

- Mr H G F S Parish, Manager: Operations Assurance Department, was invited to be a member of the IAEA's *Assessment of Safety Significant Events (ASSET) Team* mission to the nuclear power plant at Dukovany power station in the Czech Republic during October 1993. This station has four Russian built pressurised water reactors of the VVER 440 / 213 type.

- Mr S D Adams, Head: Operator Licensing Division, undertook a visit to the USA, hosted by the Nuclear Regulatory Commission, to study current US practices in respect of licensing of reactor operators and renewal of operator licences.

- Mr B C Winkler, Executive Officer, as Vice-chairman of Committee 4 of the International Commission on Radiological Protection, attended the meeting of Committee 4 held in Bournemouth during September 1993, and also attended the General Conference of the IAEA held in September in Vienna.

The IAEA's ASSET mission to Dukovany nuclear power station in the Czech Republic

international contact

In his personal capacity, Mr Winkler also attended two meetings of the South African Forum for Radiation Protection.

- Mr J Leaver, General Manager, was an adviser to the South African Delegation to the Sixteenth Meeting of the Contracting parties to the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter*, held in London in November 1993.

"THERE HAS BEEN A NOTICEABLE INCREASE IN THE TECHNICAL INFORMATION EXCHANGE WITH THE IAEA "

FINANCIAL STATEMENTS

FOR THE YEAR ENDED 31 MARCH 1994

REPORT ON THE FINANCIAL STATEMENTS

The annual financial statements were approved by the Council and signed on its behalf by Prof. J.B. Martin, Chairman and Mr. B.C. Winkler, Executive Officer.

REPORT OF THE AUDITOR- GENERAL

The accounts and the annual financial statements of the Council, set out on pages 33 to 36, and the Notes thereto have been audited in terms of *section 5 of the Auditor-General Act, 1989 (Act No. 52 of 1989)*, read with *section 49(4) of the Nuclear Energy Act, 1993 (Act No. 131 of 1993)*. These annual financial statements as well as the maintenance of effective control measures are the responsibility of the Council's Executive Officer. My responsibility is to report on these annual financial statements and the matters set out in the first-mentioned Act.

The audit was conducted in accordance with generally accepted government auditing standards. These standards require that the audit be planned and performed in such a way as to obtain reasonable assurance that, in all material respects, fair presentation is achieved in the annual financial statements. An audit includes an evaluation of the appropriateness of the accounting policies, an examination, on a test basis, of evidence supporting the amounts and disclosures included in the annual financial statements, an assessment of the reasonableness of significant provisions and a consideration of the appropriateness of the overall presentation of the annual financial statements. I consider that the audit procedures were appropriate in the circumstances to enable me to express the opinion presented below.

In my opinion, these annual financial statements fairly present the financial position of the Council as at 31 March 1994 and the results of its activities for the year ended in accordance with prescribed accounting practice.

for Auditor-General

Pretoria, 3 November 1994

financial statements

BALANCE SHEET

AS AT 31 MARCH 1994

	1994 R	Notes	1993 R
Capital employed			
Income funds	**9 088 057**		8 182 974
Capital funds	**1 745 417**	2	1 696 322
	10 833 474		9 879 296
Employment of capital			
Fixed assets	**1 109 608**	5	1 600 956
Net current assets	**9 723 866**		8 278 340
Current assets	**11 261 766**		8 881 824
Debtors	**4 670 575**	3	2 816 288
Deposits and immediately claimable amounts	**2 000**		4 000
Bank balance and cash	**6 589 191**		6 061 536
Less:			
Current liabilities	**1 537 900**		603 484
Creditors and provisions	**1 537 900**	4	603 484
	10 833 474		9 879 296

INCOME STATEMENT

FOR THE YEAR ENDED 31 MARCH 1994

	1993/94 R	Notes	1992/93 R
Net surplus (deficit)	**954 178**	6	(357 403)
Transfer to capital funds	**(49 095)**	2	(1 515 523)
Income fund -			
at the beginning of the year	**8 182 974**		10 055 900
Income fund -			
at the end of the year	**9 088 057**		8 182 974

income statement

CASH FLOW STATEMENT

FOR THE YEAR ENDED 31 MARCH 1994

	1993/94 R	Notes	1992/93 R
Cash (retained from) employed in operating activities	**(803 874)**		911 439
Cash (surplus)/deficit generated from operations	**(1 009 422)**	7	521 573
Income from interest	**(714 323)**		(1 016 332)
Employed to increase/ (decrease) operating capital	**919 871**	8	1 406 198
Cash utilised in investment activities	**278 219**		152 539
Investment to maintain operations	**278 219**		152 539
Additons to fixed assets	**278 219**	9	152 539
	(525 655)		1 063 978
Cash effects of financing activities			
Increase/(decrease) in cash on hand	**525 655**		(1 063 978)
Cash generated/(utilised)	**525 655**		(1 063 978)

NOTES TO THE FINANCIAL STATEMENTS

1. ACCOUNTING POLICIES

The financial statements are, unless otherwise indicated, compiled on the historical cost basis in accordance with the undermentioned policy which was applied consistently in every material respect.

1.1 Income acknowledgement in general

Income is recognised on the accrual basis.

1.2 State contributions received

State contributions are accounted for in the period with which the allocation is associated.

1.3 Fixed assets and depreciation

Fixed assets are shown at cost less accumulated depreciation and written off over the expected useful life according to the fixed instalment method. In addition, amounts are transferred to the capital fund to provide for the replacement costs of assets.

1.4 Expenditure for research and development

These expenditures are written off in the Income Statement in the year in which they were incurred.

2. CAPITAL FUNDS

	1993/94 R	1992/93 R
Balance at the beginning of the year	**1 696 322**	180 799
Transferred from Income Statement	**49 095**	1 515 523
Balance at the end of the year	**1 745 417**	1 696 322

Amounts are transferred to the capital fund to provide for the replacement costs of assets.

accounting policies

NOTES TO THE FINANCIAL STATEMENTS

	1993/94 R	1992/93 R
3. DEBTORS		
Trade debtors	**4 317 166**	2 531 886
Other debtors	**159 033**	107 878
Payments made in advance	**194 376**	176 524
	4 670 575	2 816 288
4. CREDITORS		
Trade creditors	**628 525**	317 358
Other creditors	**19 375**	41 126
Provision for accumulated leave	**820 000**	200 000
Provision for audit fees	**70 000**	45 000
	1 537 900	603 484

5. FIXED ASSETS

	1993/94					1992/93
	Furniture	**Computer equipment**	**Scientific & technical equipment**	**Office equipment**	**Total fixed assets**	**Total fixed assets**
	R	R	R	R	R	R
Cost	294 200	3 297 801	879 497	204 862	4 676 360	4 398 141
Accumulated depreciation	167 365	2 682 593	627 821	88 973	3 566 752	2 797 185
Book value	126 835	615 208	251 676	115 889	1 109 608	1 600 956

6. SURPLUS (DEFICITS)

	1993/94 R		1992/93 R	
Income	**18 631 050**		14 615 543	
State contribution	**4 895 000**		3 519 000	
Licensing fees	**12 291 603**		10 051 168	
Rehabilitation projects	**681 515**	**	0	
Interest	**714 323**		1 016 332	
Sundry	**48 609**		29 043	
Less: Expenditure	**17 676 872**		14 972 946	
Audit fees	**88 530**		86 843	
Consultancy	**273 767**		167 832	
Consumable stores	**52 273**		57 613	
Depreciation	**769 567**		852 162	
Personnel expenses	**12 617 246**		10 840 924	*
Postal and telephone services	**163 062**		141 261	
Publications	**117 238**		75 513	
Rent, accommodation	**718 161**		782 848	
Research contracts	**162 176**		207 065	
Service contracts and maintenance	**460 044**		252 919	
Subsistence and transport expenses	**858 663**		888 903	*
Sundry expenditure	**776 145**		619 063	
Abnormal item:				
Provision for accumulated leave	**620 000**	***	0	
Surplus (deficit)	**954 178**		(357 403)	

* **Reconstituted figures**

** **Rehabilitation projects**
The amount represents the net effect of income and expenditure in respect of work performed to monitor and control radioactive contamination of scrap materials arising from the mining industry.

*** **Abnormal item : Provision for accumulated leave**
The abnormal item pertains to the provision for the full commitment in respect of the accumulated leave. The effect thereof is a reduction of R620 000 in the net income in the present year.

income and expenditure

NOTES TO THE FINANCIAL STATEMENTS

	1993/94 R	1992/93 R
7. CASH SURPLUS/(DEFICIT) GENERATED FROM OPERATIONS		
Surplus/(deficit) for the year	**954 178**	(357 403)
Adjustment for :		
Depreciation	**769 567**	852 162
Income interest	**(714 323)**	(1 016 332)
	1 009 422	(521 573)
8. EMPLOYED TO INCREASE OPERATING CAPITAL		
Increase/(decrease) in debtors	**1 854 287**	1 023 004
(Increase)/decrease in creditors	**(934 416)**	383 194
	919 871	1 406 198
9. ADDITIONS TO FIXED ASSETS		
Computer equipment	**131 643**	81 644
Scientific and technical equipment	**71 600**	2 074
Furniture	**25 990**	27 943
Office equipment	**48 986**	40 878
	278 219	152 539