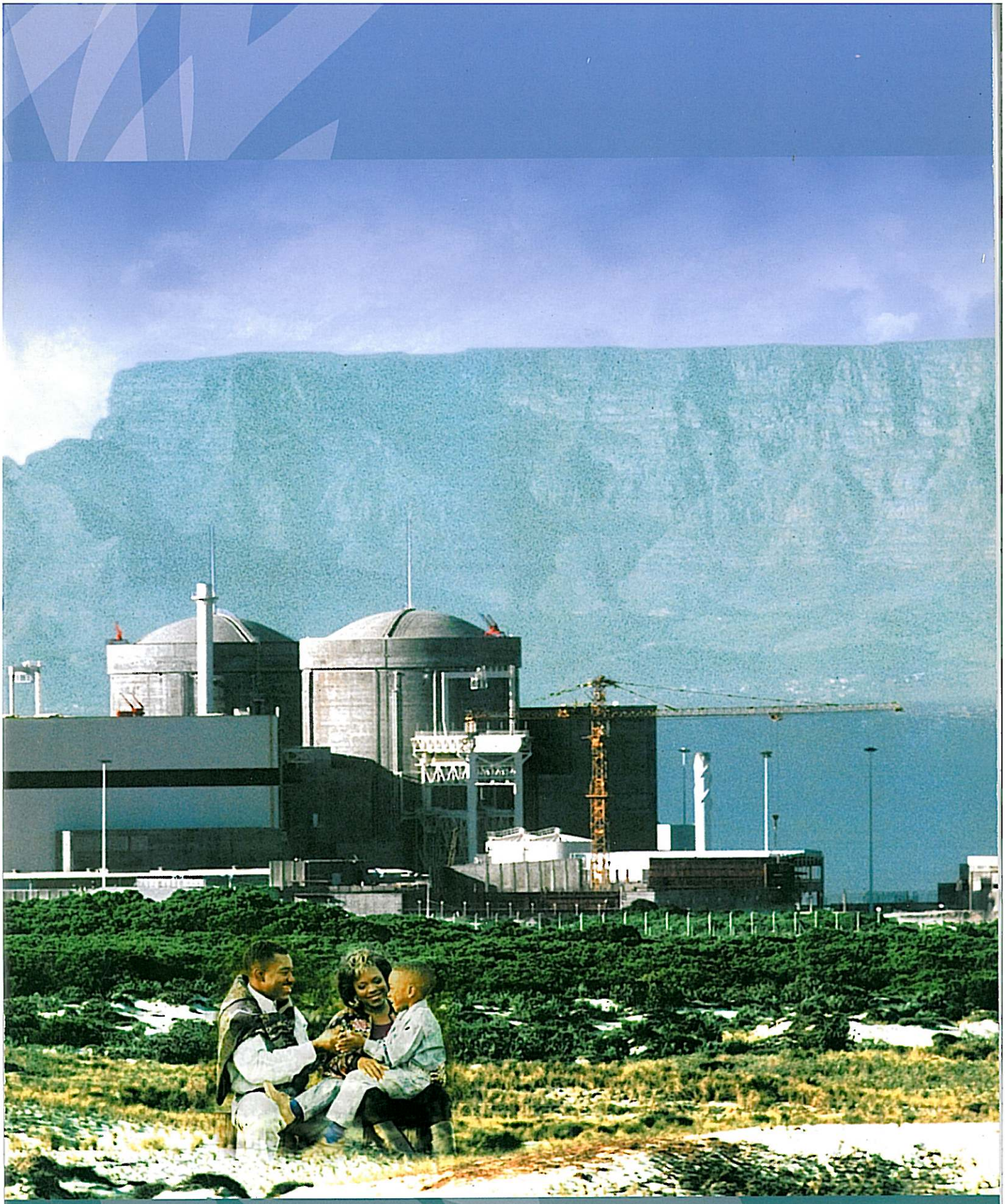


COUNCIL FOR NUCLEAR SAFETY

Annual Report 1997 / 1998



CNS Council members with the Minister of Minerals & Energy, Dr Penuell Maduna

MISSION STATEMENT

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.

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.

STRATEGY

Its strategy is 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.



Council for Nuclear Safety

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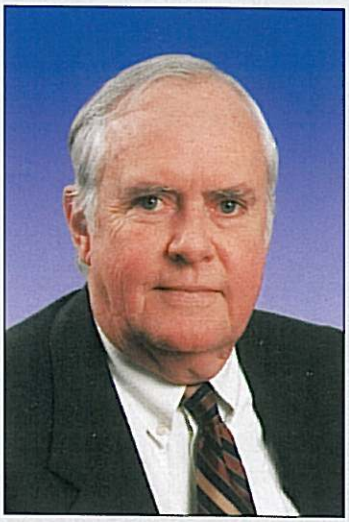
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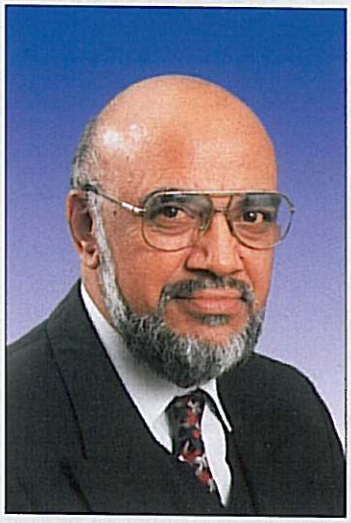
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THE COUNCIL



Prof John Martin

Prof John Martin, the chairman of the CNS board, is Deputy Vice Chancellor (Research) of the University of Cape Town. He has lectured both locally and abroad since 1958, has received numerous awards and is known for what colleagues term a "phenomenal" research output.



Prof Krishanlal Bharuth-Ram

Prof Krishanlal Bharuth-Ram is head of the Physics Department at the University of Durban-Westville. He holds a doctorate in Nuclear Physics from Oxford. He has co-authored 50 publications and has received several scholarships and awards.



Dr Thomas Auf der Heyde

Dr Thomas Auf der Heyde is Director of the Science Advice Unit and is Senior lecturer in the Department of Chemistry (UCT). Between 1992 and 1995 he undertook various research projects at Bern, Cambridge and Princeton Universities. He has published 20 papers.



Prof Hannes Klopper

Prof Hannes Klopper heads the Department of Nuclear Medicine at Tygerberg Hospital, Cape Town. He has lectured and consulted in the field both locally and abroad since 1972, and has 70 publications to his credit.



Prof Simeon Taole

Prof Simeon Taole holds a doctorate in solid state physics from the University of Ottawa, and has contributed to numerous publications and conferences.



Mr Bert Winkler

Mr Bert Winkler, the Executive Officer of the CNS, holds a MSc in Physics from the University of Stellenbosch. His entire career has been associated with the nuclear industry in South Africa, with the focus on radiation protection and nuclear safety. He is presently Chairman of Committee IV of the International Commission on Radiological Protection, the recognised international body developing safety standards for radiation protection.



Dr Maki Mandela

Dr Maki Mandela is the Assistant General Manager: Human Resources, of Spoornet. She has a PhD in Anthropology from the University of Massachusetts, and has spent seven years working in the United States and Kenya.



Dr Daan Rietmann

Dr Daan Rietmann is a former director of the CSIR's National Accelerator Centre. He holds a doctorate in Physics from Oxford. He has co-authored almost 50 publications and has contributed to numerous local and international conferences.

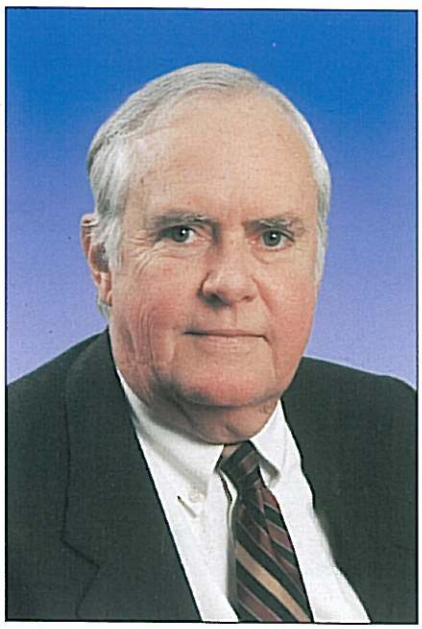
CHAIRMAN'S REPORT

The general responsibility of the Council is to give guidance in policy matters to the executive and the staff of the CNS, and to monitor the implementation of the core business of the regulatory function.

During the year under review, the Council was closely involved in a number of broad initiatives. First of these was the development of an employment equity policy, designed to lead to staffing of the CNS which more closely reflects the composition of the South African population. Significant progress has been achieved in formulating a policy in an inclusive process in which all categories of staff took part. Implementation reached an advanced stage in the year under review.

The Council continued to contribute to the formulation of a new act to govern the nuclear regulatory function, as instructed by the Minister at the time. To ensure transparency and stakeholder consultation, a number of public meetings were held to consider the draft at various stages. The Council was substantially involved in the process of redrafting after each of these inputs.

During the consultation process the Council became aware of the need for interested and affected parties to have an advisory forum where views can be discussed and advice formulated to aid Council in its deliberations. The forum is intended to provide advice to the Council, and the process to establish it was initiated by the Council rather than the Executive. The process, which has again involved wide consultation, is expected to be completed in the coming year and will lead to an Advisory Committee on Radiation Safety (ACORS). The main function of ACORS will be to provide a forum for the discussion of radiation standards and regulatory practices, and for the formulation of recommendations to the Council.



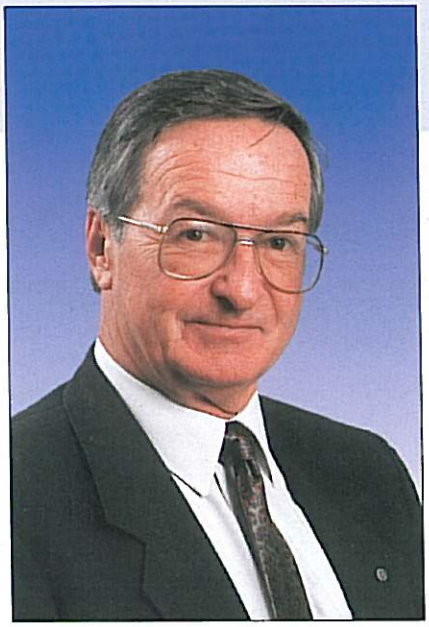
Prof John Martin

Prof John Martin
Chairman

EXECUTIVE OFFICER'S REPORT

The membership of the Council (or Board) of the CNS remained unchanged over the reporting Period. Under the Chairmanship of Professor John Martin of the University of Cape Town the Council held six meetings, one of which was held at the Vaalputs National Radioactive Waste Repository.

In addition, the Council initiated two preliminary meetings with interested and affected parties with a view to establishing an Advisory Committee in order to bring particular matters of regulatory concern directly to the attention of the Council.

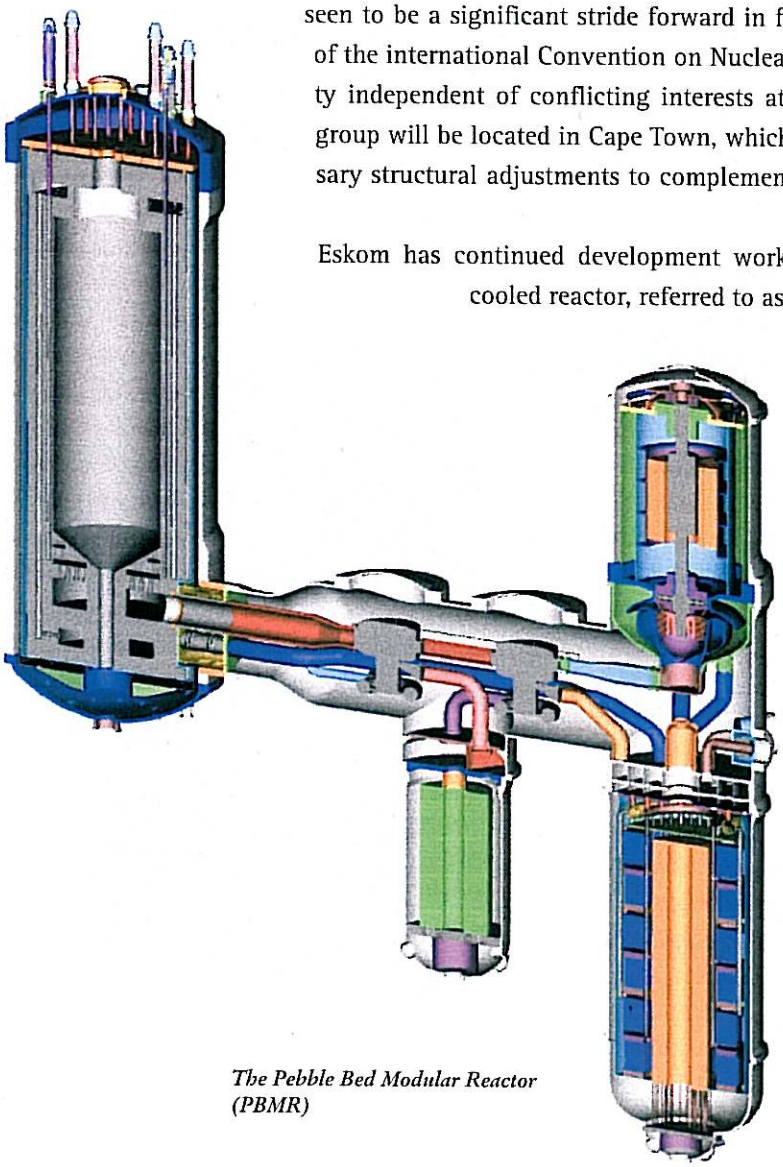


Mr Bert Winkler

The reporting period has seen a series of developments that have necessitated the consideration of some adjustments to the structure of the Council for Nuclear Safety (CNS). Amongst these, it has been recognised that there will be a need to transform the organisation into one more representative of the population whilst at the same time maintaining the high levels of scientific and technical skills necessary to provide an assurance of acceptable nuclear, radiation and radioactive waste safety. Within Eskom, a thorough review of the corporate governance of nuclear safety and developments with the proposed Pebble Bed Modular Reactor resulted in a series of changes which had to be complemented within the CNS. These prime driving forces also gave rise to the opportunity to integrate more of its technical assessment capabilities within the discrete project discipline areas and to focus dedicated effort in the areas of safety standards and development. These changes have been formulated throughout the year in consultation with the staff and the Council and will be implemented during the forthcoming year. On the transformation side, the CNS is in the process of developing an affirmative action policy, which will ensure that at least fifty percent of the staff at all levels will be comprised of persons from designated groups. A bursary scheme has been implemented and personnel development and training programmes will be formulated to ensure the development of the necessary skills within a commensurate timeframe.

Following representations to Eskom regarding the corporate governance of nuclear safety within its organisation, various significant changes have been considered. Concerns had arisen that the responsibility for nuclear safety had become both too diffused and too close to the operational structures. Eskom responded to the concerns of the CNS and formulated a proposal to establish a series of committees reporting at senior executive and board level. The establishment of a group at senior management level with consolidated responsibility for all elements of nuclear, radiation and radioactive waste safety and emergency pre-

paredness has also been proposed. The group would be completely separate from the managerial structures responsible for operational activities. These developments are seen to be a significant stride forward in fulfilling the obligations incurred by way of the international Convention on Nuclear Safety to maintain all elements of safety independent of conflicting interests at all levels. The corporate nuclear safety group will be located in Cape Town, which will require the CNS to make the necessary structural adjustments to complement these developments.



The Pebble Bed Modular Reactor (PBMR)

Eskom has continued development work on the modular high temperature gas cooled reactor, referred to as the Pebble Bed Modular Reactor (PBMR). The development work has been concerned largely with design and economic feasibility studies, both significantly influenced by nuclear, radiation and waste safety issues. In order to progress the work, dialogue has been maintained with the CNS and a stage has now been reached where an in-depth study of licensibility must be undertaken. Such a study requires considerable expertise and effort and mechanisms to source these have been given extensive consideration during the year. The proposed design incorporates various elements of technology that differ significantly from the Koeberg pressurised water reactors, particularly with regard to high operating temperatures, graphite moderation, gas cooling and fuel design. The necessary experience in these technologies will have to be obtained on a contractual basis from suitable overseas organisations. Again the structural adjustments within the CNS will be made in such a way that the necessary transfer of technology can be facilitated. The approach to be adopted in determining licensibility has remained under development and will include an international peer review process to ensure compatibility with international norms and standards of nuclear, radiation and radioactive waste safety.

The standard of safety at the Koeberg nuclear power station has generally been maintained at a high level, although a few operational occurrences did indicate some safety concerns in the area of worker radiation protection. These events were deemed to arise owing to operational pressures aimed at improved economic operation of the power station. Whilst significant in terms of deviation from laid down procedures, the events did not give rise to any serious radiological consequences to the workers concerned and had no impact on

nuclear safety. The separation of nuclear safety governance from operational responsibility should contribute significantly to preventing a recurrence.

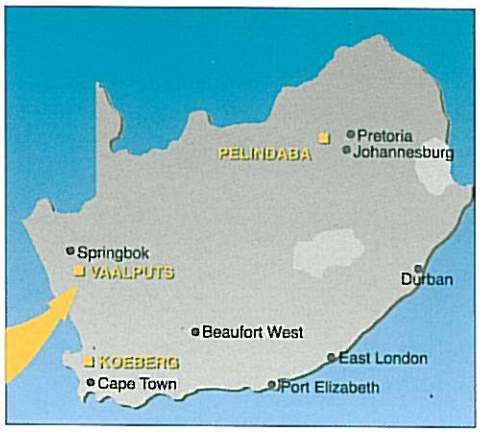
The major periodic safety review at Koeberg has continued throughout the year. This review is a large scale undertaking with a time scale of two years and where all elements that contribute to safety from both design and operational aspects are being thoroughly evaluated and compared against prevailing internationally recognised standards. The project is well advanced and, to date, whilst a range of areas has been identified where improvements in safety can be made, no major safety concerns has been raised. Upon completion, the review should provide the necessary confidence that the maintenance of components and equipment of the power station and its operation have been conducted in such a way that safety standards have been maintained and that operations may continue for the foreseeable future.

As urban development has taken place within the Cape metropolitan area, pressures have arisen to develop within the environs of Koeberg. Whilst such developments were always foreseen, careful structure planning and control of development is necessary in order to ensure that nuclear emergency planning and preparedness arrangements are not compromised. The safety review process has given extensive consideration to this aspect and close liaison has been maintained between Eskom, the CNS and the local planning authorities to ensure that no unnecessary problems will arise.

Significant progress has been made in the control of radiation hazards associated with the mining and processing of radioactive ores and minerals. These hazards are being considered in terms of three areas, namely, exposure to the underground workforce, exposure to surface workers and exposure of the public. The latter arises from effluent discharges, migration of contaminants from mine sites into the environment, recycling or use of contaminated materials and residues, transport of radioactive materials in the public domain and the use of residually contaminated land. Eighty percent of underground working areas have now been assessed and estimates made of radiation exposure to workers in those areas. These assessments revealed that exposure levels were acceptable in many areas but also identified a number of areas where large numbers of workers were receiving radiation doses in excess of the annual limits. The CNS viewed this situation in a very serious light and pressures were brought to bear on the mining companies concerned to improve conditions in these areas. Representatives of the workers exposed to these high levels of radiation are being consulted regarding the situation. Radiation hazards to workers involved in surface operations are now generally under adequate control and good progress is being made in the development of methodologies for the systematic assessment of hazards to the public. The management of radioactive waste from the mining and minerals processing industries remained less than satisfactory; particularly the longer-term management of such wastes and the control over contaminated scrap metal. Little progress has been made with the rehabilitation of off-mine sites contaminated in the past due to inadequate control of material released from mine properties. The limited progress is largely due to the need for a national waste management policy providing direction for the management of wastes arising from rehabilitation activities.

EXECUTIVE OFFICER'S REPORT
(continued)

Activities at the Pelindaba site of the Atomic Energy Corporation (AEC) have diminished significantly in the recent past and a reduction in staffing levels has taken place. Although levels of safety have been maintained, careful monitoring was essential to ensure that sufficient resources were retained to ensure this remained the case. The safe decommissioning of facilities requires a degree of corporate memory to be available and adequate arrangements for the management of wastes arising from decommissioning operations remains an issue to be resolved pending the establishment of a national policy for radioactive waste management.



Location of the National Radioactive Waste Repository at Vaalputs

Some concerns have arisen over operations at the site of the Vaalputs National Radioactive Waste Repository owing to the waste management regime adopted by Eskom at the Koeberg nuclear power station which entails long periods between shipments to the Vaalputs site. This has caused waste packages placed in the disposal trenches to remain uncovered for long periods exposing them to the prevailing weather conditions which caused some degradation of package integrity. This resulted in the seepage of some contamination to the surfaces of some packages. No contamination has been released to the environment and no radiation hazards to workers or the public have arisen. Measures have been put in place to rectify the situation and to prevent recurrence. As mentioned above, the absence of a national radioactive waste management policy continued to exacerbate problems in this area.

On the legal side, revision of the legislation controlling the activities of the CNS and the Atomic Energy Corporation has been taken over by the Department of Minerals and Energy and the Council will provide input into this process.

The international Convention on Nuclear Safety has been signed and ratified and the CNS maintained close liaison with the International Atomic Energy Agency (IAEA) in the formulation of procedures for the implementation of the Convention.

The international Joint Convention on the Safety of Spent Nuclear Fuel and the Safety of Radioactive Waste Management was adopted by a Diplomatic Conference at the IAEA and a recommendation has been made to the Minister of Minerals and Energy that South Africa should sign and ratify this convention.

Nuclear, radiation and radioactive waste safety are matters of international concern and close liaison has been maintained with various parties at the international level. The development of international conventions in these areas highlights this dimension and prevails upon countries around the world to meet the internationally endorsed standards of safety, established in these discipline areas. The CNS has kept abreast of these developments by establishing and maintaining exchange agreements with regulatory authorities in other countries. These include the United States, Britain, France and Canada, all of which have a range of regulatory responsibilities similar to the CNS. Development has also been assisted

by actively engaging in the activities of the International Atomic Energy Agency particularly in the processes of international safety standards development. The Executive Officer, Bert Winkler, served as Chairman of the International Commission for Radiological Protection (ICRP) Committee IV and Phil Metcalf, Deputy General Manager, as Chairman of the IAEA Radioactive Waste Safety Standards Advisory Committee. Several staff members actively participated in the standards development processes of the IAEA.



IAEA Regional Workshop on Regulatory Compliance and Enforcement Action for Radiation Safety, held in Johannesburg on 26 -30 May 1997.

The CNS has also become increasingly involved in the development of radiation safety training initiatives with local universities and has provided a large measure of support and assistance to the IAEA in its technical assistance to developing countries, mainly within the African region.

Mr Bert Winkler
Executive Officer

SAFETY STANDARDS AND DEVELOPMENT

In the context of nuclear safety, radiation safety, the safe management of radioactive waste and the safe transport of radioactive material, safety standards cover a broad range of philosophical principles and their application to a diverse range of activities. These vary from engineering standards for the design, construction and operation of nuclear reactors, standards for the training of radiation protection scientists and technicians through to fundamental safety standards. Also included are standards for the clearance of potentially contaminated materials from operating facilities, for the discharge of effluents and the standards for repositories suitable for the disposal of high level radioactive wastes such as spent nuclear fuel. Equally important, to achieve and demonstrate that acceptable levels of safety have been maintained, is to formulate and apply standards of regulatory control at a level commensurate with the potential hazards associated with regulated activities. Maintenance of such standards of regulatory control is emphasised in the relevant international conventions on nuclear, radiation and waste safety and is also a major focus of the safety standards developed by the International Atomic Energy Agency. As technology develops and operational experience is gained, these standards must be continually reviewed and revised as necessary. This process necessitates the CNS to continually review operational information from local operations and at the international level and to main-

tain an involvement in the standards development process at the national and international level. The CNS continues to have an active involvement in these processes and the outcome is reflected in the regulatory process adopted and in the application of regulatory processes and tools.

DEVELOPMENT OF ANALYSIS TOOLS

Risk Spectrum

Risk Spectrum, a computer code used in probabilistic risk assessment (PRA), has been received from RELCON, Sweden and has been installed and tested on a CNS PC workstation. The fault trees for the Koeberg PRA have been successfully converted to run on Risk Spectrum. The complete database and event trees will be converted during 1998.

RELAP-5 Code

RELAP-5 is one of the main tools used on modelling nuclear reactor behaviour and has been obtained from the United States Nuclear Regulatory Commission (NRC) in terms of a formal agreement between the CNS and the NRC. With the assistance of the AEC, the CNS has successfully run RELAP-5 to obtain steady-state conditions for Koeberg. These are presently being compared with data provided in the Safety Analysis Report. These will serve as initial conditions for accident studies to be performed by the CNS as independent verification of Eskom submissions on accident analysis work relating to the Safety Analysis Report.

Environmental Impact Assessment Codes

The CNS has acquired the RESRAD code from Argonne National Laboratories, USA and has obtained a copy of IMPACT, from Beak Consultants of Canada, on approval. Developments in codes for the assessment of off-site consequences close to licensed facilities are under review.

Geographical Information System (GIS)

Detailed geographical information relating to areas surrounding licensed sites is needed to conduct impact assessments for members of the public. Two sets of digitised maps, covering areas surrounding the sites of all current licensees, have been ordered and will be run on the CNS GIS system ARCVIEW. These are comprised of the ENPAT data set provided by the Department of Environmental Affairs and Tourism and a selection of 1:50,000 map sheets provided by the Surveyor General. Conversion of the latter data to ARCVIEW format is being arranged in conjunction with Geographical Information Management Systems (GIMS) and training of project staff will be undertaken.

Best Estimate Risk Assessment And Uncertainty Analysis

A work programme has been established for risk uncertainty analysis on the environmental impact assessment aspects of the Koeberg Probabilistic Risk Assessment.

KOEBERG NUCLEAR POWER STATION



The coastline at Koeberg Nuclear Power Station.

SAFETY ASSESSMENT

As reported in the 96/97 CNS Annual Report, a periodic safety re-assessment process, complementary to the on-going licensing activities conducted to date, was initiated for the Koeberg Nuclear Power Station in that reporting period. This safety re-assessment, scheduled for completion over a two-year period, has two primary objectives. Firstly, it will compare the design bases of the systems and components at Koeberg and the operating practice with currently recognised international standards. Secondly, it will validate the risk assessment methodology employed and ensure that the plant still meets the risk criteria laid down in the fundamental safety standards of the CNS, taking into consideration the cumulative effects of modifications and plant ageing. The safety re-assessment project named "The Koeberg Safety Report" has been sub-divided into several sub-projects in order to ensure efficient project management.

During the reporting period, significant progress has been made in the execution of the various sub-projects. Updating and consolidation of the licensing safety documentation into a standard Safety Analysis Report (SAR), reflecting the plant status as at April 1997, has been finalised by Eskom. The updated Safety Analysis Report has been structured along the lines of that currently used in France and the French approach was selected as the international reference for purposes of comparison.

As part of its review, the CNS conducted an audit on the processes adopted by Eskom to compile the SAR, as well as a technical review of its scope and content. No major safety concerns were identified and the Safety Analysis Report, after some minor adjustments following CNS review, was approved for reference in the Koeberg nuclear licence.

Updating and consolidation of the General Operating Rules (GOR) documentation was also completed. This task proved to be relatively straightforward, as this documentation had been maintained current and up-to-date on an on-going basis.

The comparison between the selected French reference safety case and the updated Koeberg safety documentation identified approximately five hundred differences. Following an approved screening process, approximately one hundred and twenty of the differences with potential safety significance were retained for further assessment, the balance being determined by the CNS as having no nuclear safety significance. During the process, no difference was identified as requiring immediate corrective action. All differences were recorded in a "Difference File" to be retained as an integral part of the safety documentation.

As part of its review, the CNS conducted an audit on the processes used by Eskom as well as a technical review of a representative sample of selected differences. The CNS identified no major concerns. Assessment of the relevant differences, as well as other topical safety issues identified during the above projects, is still progressing as part of the safety re-assessment process. This process has also included benchmarking of the Koeberg Risk Assessment against a credible international reference. The findings of the safety re-assessment will be assessed and prioritised in order to identify corrective actions necessary to address any shortcomings or significant safety concerns.

Emergency Planning And Preparedness

As part of the periodic safety re-assessment process, the Koeberg Emergency Plan was revisited. The services of a Canadian consulting company were utilised by Eskom to conduct the review. The objective of the review was to assess the adequacy and viability of the present planning and preparedness arrangements. The consultants were contracted to provide a review of the technical basis for the Koeberg Emergency Plan. Using this revised technical basis, the consultants were also contracted to review the adequacy of current emergency planning and population development arrangements. The review also considered, inter alia, an evaluation of current preparedness and response arrangements, an evaluation of proposed development plans and a population development-screening tool. Whilst the studies are not yet complete, indications are that the present arrangements are not unrealistic, based on the reference accidents considered. It is also indicated that, based on the existing population, emergency preparedness is adequate. However, several areas warranting improvement have been identified. Particular emphasis needs to be placed on co-ordination between the off-site organisations and their respective responsibilities.

Off-Site Impact Assessments For Input To The SAR

Work is in progress to reassess the consequences of routine operational discharges from Koeberg on the surrounding population and the environment. Annual discharges of

radioactivity in liquid and gaseous effluent are determined by Eskom using an approved activity migration model. The radiological consequences of these discharges to members of the public are then computed by the CNS using the IMPACT code. The annual discharges of radioactivity computed by Eskom, using the activity migration model, are under review.

Sensitivity studies, performed using the COSYMA code to calculate radiological consequences resulting from an accidental release, are being compared with similar studies performed by Eskom using the PC-COSYMA code and accident source terms derived from the MAAP code.

Accident Analysis Aspects Of The SAR

The re-assessment process has considered a number of aspects of accident analysis. In particular, these have focussed on classification of design base accidents, criteria for design base accidents, additional accidents that need to be analysed, accident analysis methodology and the presentation of results in the Safety Analysis Report. Submissions by Eskom, on the above aspects of the SAR, have been reviewed and commented on by the CNS.

Structure Of The SAR

In depth consideration has been given to the structure and content of the Safety Analysis Report. It has been agreed that the regulatory requirements should be clearly elaborated in each chapter of the report which will then demonstrate how compliance with the requirements has been achieved. With the objective of streamlining the licensing process from both the Eskom and CNS points of view, the SAR will be structured in such a way that the user of the document is able to link the licensing requirements to the sections of the SAR dealing with compliance.

Accident Management

Further consideration has been given to the issue of severe accident management. Whilst the safety analysis of Koeberg must demonstrate compliance with safety criteria without the need to resort to severe accident management arrangements, as with emergency planning and preparedness, good operating practice indicates that contingency arrangements should be in place. The considerations have addressed accident procedures, severe accident management guidelines, emergency planning, licensing aspects, credit for accident management in the safety case and the development of an accident management manual.

Urban Developments

The CNS has developed a proposal for guidelines on population density control in the vicinity of the Koeberg nuclear power station. This has been provided to Eskom and the local authorities, and will serve as the basis for discussions with the authorities on limitations regarding population development in the vicinity of the power station. This guideline has been developed taking into account criteria used in other countries and is supported by the Koeberg probabilistic risk assessment. Close liaison has been maintained with the planning departments of the local authorities within the environs of the power station.

Risk Management Project

Eskom has submitted a project plan for development of a risk management process for ongoing and dynamic demonstration of compliance with the risk criteria laid down for Koeberg. The process will allow consideration to be given to the acceptability of components and equipment becoming inoperable or being taken out of service for maintenance. This project will include data collection, occurrence analysis and trending, management of the probabilistic risk assessment, safety assessment of planned and unplanned activities and management of generic safety issues. This project plan has been assessed and accepted by the CNS.

Koeberg Spent Fuel Storage

Spent nuclear fuel removed from the reactors at Koeberg is stored in storage pools in buildings adjacent to the reactor buildings with each unit having its own dedicated pool. The current storage capacity is limited and, by the year 2000, Eskom will need to have additional spent fuel storage capacity in order to meet the current licensing requirements. An option under consideration by Eskom is to extend the storage pool capacity. In May 1996, Eskom approached the CNS with a proposal to modify the storage capacity of the pools that would entail increasing the density of the current storage area. In accordance with licensing requirements, such a change requires a full justification by Eskom and submission of an appropriate safety case. This must, inter alia, address the fitness-for-purpose of the proposed design in terms of respecting acceptable international norms and practices as well as a demonstration of compliance to the safety criteria laid down by the CNS. Consultations with Eskom, involving detailed technical discussions, will ultimately result in the submission of a Licence Change Request, scheduled for November 1998. It is anticipated that the CNS review will be completed by the first quarter of 1999.

COMPLIANCE ASSURANCE

Assurance of compliance with all conditions of licence and safety requirements is obtained by a series of mechanisms including CNS evaluation of routine reports and occurrence reports, audits of different aspects of the power station operation and by routine and non-routine inspections and other surveillance activities.

Inspection Of Unit 1 Reactor Pressure Vessel

During the ninth refuelling outage of Unit-1 in 1997, the scheduled in-service inspection (ISI) of the reactor pressure vessel was carried out. The scheduling of these inspections is in line with the requirements of the mandatory ISI programme at Koeberg and was the second ISI carried out on this vessel since the plant was commissioned. The first site inspection of this vessel was, however, conducted prior to commissioning and is referred to as the pre-service inspection (PSI). This was undertaken in 1982 by the German company MAN as was the first ISI, which was performed in 1991 during the fourth refuelling outage.

The second ISI was performed by Siemens using their new phased array system, SAPHIR. One feature of this system is that of advanced imaging ultrasonic techniques with a potential for realistic sizing which combines defect detection and analysis capabilities in one instrument. The main characteristic of the phased array technique is that all angles of incidence for one scanning direction can be generated by one phased array probe. Hence detection and sizing of defects can be carried out with the same probe by just changing the delay times required to generate the specific sound field necessary to perform the sizing.

The scope of the intended work was successfully completed and the conclusion arising from this inspection was that the ultrasonic sensitivities were met for all practical purposes. Comparison with previous results showed no evolution of known flaws and the new flaws detected were only found in areas which were not previously inspected and were not service related. The condition of the clad surface and of the vessel welds is equivalent to those of similarly designed plants. Finally, the bi-metallic and safe end welds were evaluated as having no problems.

Operator Licensing

An assurance must be maintained that the operators who control the Koeberg reactors have and maintain adequate knowledge and skills to perform their duties in a safe and competent manner. This is accomplished by applying the normal regulatory practices of prescription, inspection and disclosure.

During the last reporting period, a Systematic Approach to Training (SAT) was introduced to improve the ability to audit job applicability and effectiveness of operator training. This has progressed slowly as the scope of the project has been increased. In addition to meeting international guidelines, the SAT process will now meet the requirements of the South African Qualifications Authority as prescribed in the National Qualifications Framework. This will result in the licensed operators receiving recognition for their training. It is envisaged that after accreditation, a reactor operator licence will be awarded the same recognition as a B.Sc. engineering degree. The bases for this training programme are now set and completion is expected at the end of 1999.

During each simulator evaluation of a licensed operator, Eskom is required to complete reports covering the various aspects of competency. This amounts to twelve reports per operator per year. The competencies are tracked and assessed allowing either remedial action for the individual or the improvement of the training programme. The knowledge, skills and abilities of each operator are therefore constantly tracked, allowing the CNS to regard the issue of a 'problem report' as a failure rather than as a starting point for investigation.

Following the identification of potential problems in operator competency standards by the CNS and Eskom, Koeberg operating staff were required to undertake an intensive Operator Enhancement Programme (OEP). This programme included additional training, examination and re-qualification of competencies over an extended period which culminated in the CNS gaining added assurance that the standards for licensed operator performance at Koeberg had been adequately met.

The OEP was completed in May 1997 whereupon the CNS required Eskom to implement an upgraded re-qualification training programme to maintain the standards achieved by the OEP. Regular CNS monitoring of this re-qualification has been carried out and several revised licence documents were produced by the CNS setting out detailed requirements. These licence requirements are based on recognised international norms and practices such as the United States Nuclear Regulatory Commission (NRC) standards and will assure adequate evaluation and control of operator competency. The CNS also carried out systematic audits of Eskom's training processes to determine the status of compliance with the licence requirements and the adequacy of documentation. Several weaknesses in the training systems were identified and Eskom was required to rectify the situation without delay. In the spirit of consultation and transparency, the CNS has participated with Eskom senior management in meetings and discussions with the operators, examiners, instructors and worker representatives to explain the CNS position on safety assurance and licence requirements for operators.

The situation has led to increased pressures on operators, training staff and management at Koeberg to meet the requisite demands for reassurance of operator proficiency and safety in the climate of cost reductions and revised labour legislation.

Operator Training Audit

A CNS audit assessed the Operator Training Programme currently being implemented at Koeberg. Two Licence Issues had previously been raised concerning the implementation of licence requirements. Several deviations, directly related to the two Licence Issues, were observed and recorded during the audit. Correction of these deviations will be systematically tracked and will only be closed once suitable corrective actions have been applied. An area of concern observed during the audit was that certain findings indicated as closed on the database were still open. The extent of this matter is currently under investigation by the CNS.

Combined CNS/Eskom Audit On The Chemistry Programme

The first of the combined audits, directed at the assessment of the Chemistry Programme, was carried out and no significant deviations were found.

Combined CNS/Eskom Audit On The Nuclear Engineering Programme

The second of the combined audits was focussed on the Nuclear Engineering Programme; Design and Modification Control. The overall conclusion was that the programme was satisfactory, however, most of the procedures were beyond the scheduled review date. The reason provided for this finding was the shortage of manpower within the various sections and the matter is being addressed.

Problem Notification And Reporting System

A follow-up surveillance on the implementation and feasibility of the recently implemented electronic problem notification reporting (PNR) system was conducted. With the excep-

tion of the back-fitting of the quality assurance findings into the database, the new system is working satisfactorily.

SAFETY INDICATORS

Occupational Exposure To Radiation

The risk to operating personnel arising from exposure to radiation at Koeberg is controlled by the operational radiation protection programme. Consistent with CNS licensing requirements, this programme has the dual objectives of ensuring that no occupationally exposed individual exceeds the annual dose limit, and that all exposures are kept As Low As Reasonably Achievable (ALARA). With regard to the former, a system of controls is in place to continually monitor and evaluate individual doses to ensure that all exposures are planned and are within the annual dose limit. With regard to optimisation of protection, the operational radiation protection function includes a formal ALARA programme, which is designed to evaluate tasks on the basis of the level of radiation hazard presented, and prescribe the necessary level of protection.

A summary of Koeberg occupational exposure data for all radiation workers from 1985 to 1997 is shown in Table 1 below.

Table 1

KOEBERG OCCUPATIONAL EXPOSURE DATA 1985-1997

Year	No. of individuals exceeding 20 mSv y^{-1}	No. of individuals exceeding 50 mSv y^{-1}	Average annual dose to the occupationally exposed population [mSv]	Annual collective dose [person-mSv]
1985	0	0	0.307	535.80
1986	0	0	0.894	1647.13
1987	30	0	1.718	2960.51
1988	3	0	1.047	1694.84
1989	0	0	0.711	1141.68
1990	10	0	1.349	2523.58
1991	2	0	0.999	1636.89
1992	0	0	0.849	1489.90
1993	3	0	1.528	3073.70
1994	0	0	0.954	1612.54
1995	2	0	0.871	1405.74
1996	5	0	1.242	2219.40
1997	5	2	1.395	2484.48

Figure 1 illustrates the dose distribution arising from the individual exposures accrued during 1997.

Figure 1

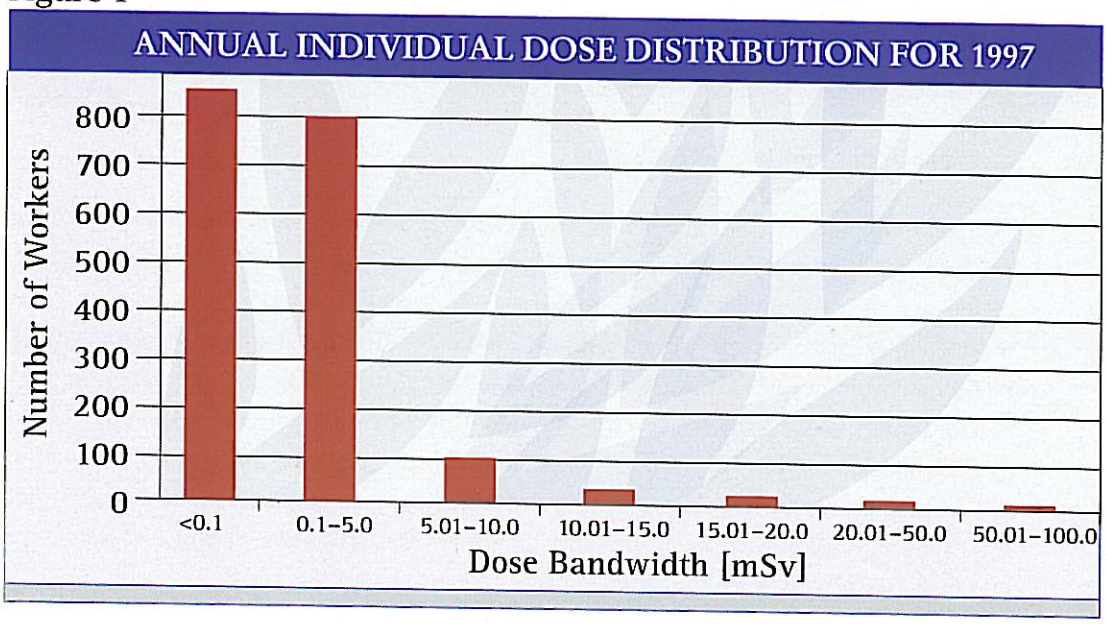
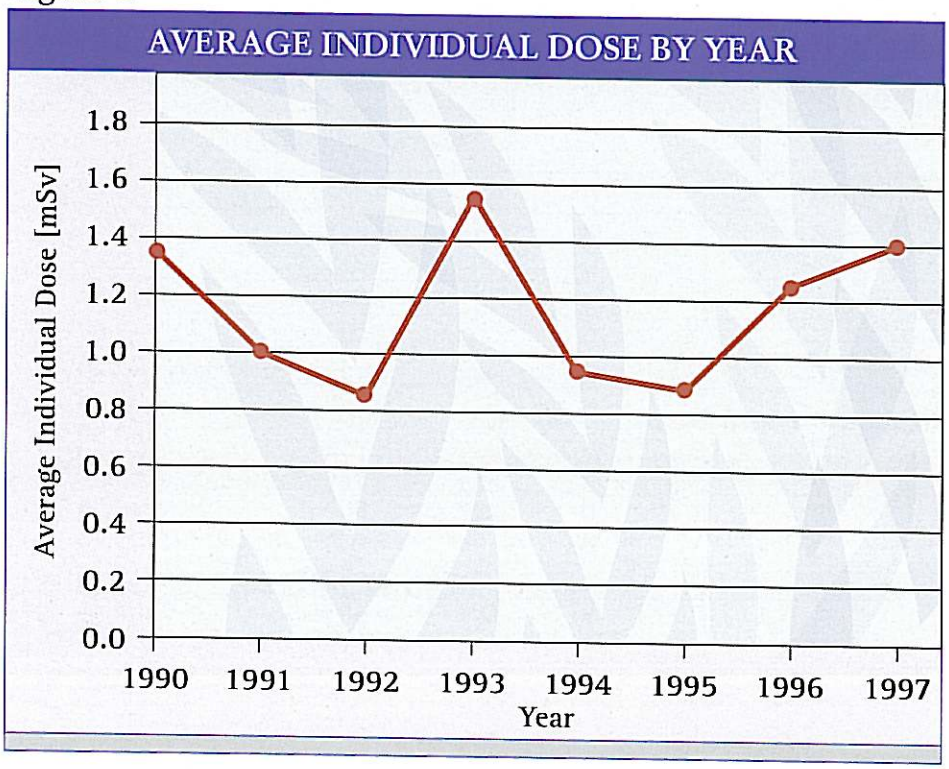


Figure 2 illustrates the variation in average individual dose from 1990 to 1997. The peaks evident for the years 1990, 1993, and 1997 are due to two refuelling outages occurring within those years. Historically, outage activities give rise to the greatest potential for occupational exposure with outage collective dose contributing about 70% of annual collective dose. The collective dose for refuelling outages 109 and 208 were 0,88 person-Sievert and 1.06 person-Sievert respectively. The collective dose accrued as a result of the two outages contributed 78% of the total annual collective dose recorded for the year 1997.

Figure 2



Compliance With The Dose Limits

With the exception of 1997, all exposures were kept below the dose limit. During that year, two individuals received doses of 91.54 and 72.79 mSv respectively, which were higher than the annual limit. These personnel were involved in an incident which led to unplanned exposure whilst undertaking a routine filter change operation. The doses accrued had resulted in no detectable health effects in the individuals concerned and the incident was subject to an investigation which identified the cause. Corrective action to prevent a recurrence has been satisfactorily implemented.

Compliance With The ALARA Objective

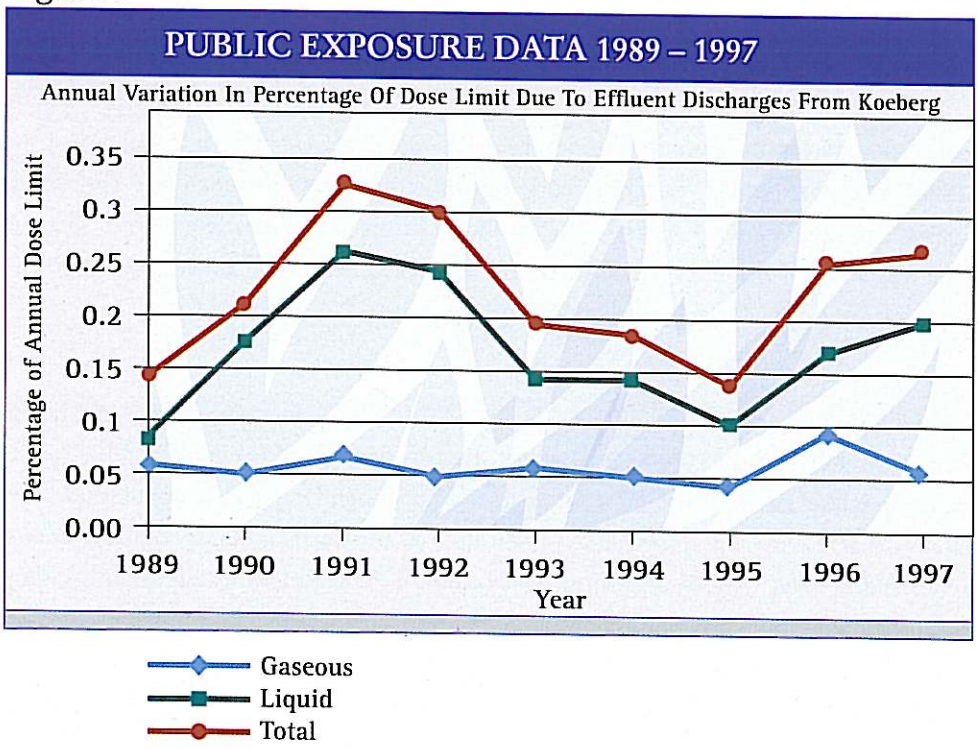
The numerical indicator selected against which the effectiveness of the ALARA programme is evaluated is the average annual dose to the occupationally exposed population. The objective is that the average individual annual dose to the occupationally exposed population does not exceed 10 mSv. Table 1 provides data for the variation of this quantity from 1985 to 1997. The total occupationally exposed workforce during 1997 numbered 1781 indicating an average annual individual dose of approximately 1.4 mSv - a factor of more than 7 below the ALARA criterion. It is also noteworthy that the average annual dose to the occupationally exposed workforce has never exceeded 1.7 mSv. Koeberg continues to maintain an internationally comparable standard in this area.

Public Exposure

The routine operation of nuclear power stations results in the generation of a certain amount of radioactive waste, which has to be safely managed. Operational radioactive waste arisings comprise of gaseous and liquid effluent and a range of materials that become contaminated during operation and maintenance of the plant. Exposure of the general public arising from the operation of Koeberg is limited by controlling the discharge of potentially contaminated effluent streams both to the atmosphere and into the sea. Authorised levels have been established for the discharge of treated liquid and gaseous effluent. The CNS specifies so-called Annual Authorised Discharge Quantities (AADQ's) for radionuclides in liquid and gaseous effluent, together with monitoring requirements for the various effluent streams. These quantities are established taking into account both the dose limit to members of the public and the ALARA principle. The effective management of radioactive wastes ensures that the annual dose limit to members of the public is not exceeded and that the generation, treatment and discharge of radioactive waste is optimised.

During the year under consideration, radioactivity in liquid and gaseous effluent discharged from Koeberg contributed a total individual dose of 0.67 µSv with 73% of this dose contributed from radionuclides discharged in liquid effluent. This falls well within the dose limit for members of the public imposed by the CNS of 250 µSv per annum. Figure 3 illustrates the annual variation in percentage of dose limit due to effluent discharges from Koeberg from 1989 to 1997.

Figure 3



It is evident that the annual dose arising from effluent discharges from Koeberg has been consistently low at less than 1% of the dose limit for members of the public. The radionuclides which contribute the highest dose as a result of atmospheric and liquid discharges are tabulated in Table 2 below.

Table 2

DOMINANT RADIONUCLIDES CONTRIBUTING TO PUBLIC DOSE FOR 1997

RADIONUCLIDES DISCHARGED IN EFFLUENT DURING 1997			
Atmospheric Transport Pathway		Liquid Transport Pathway	
Radionuclide	% Of Dose Via Pathway	Radionuclide	% Of Dose Via Pathway
^{3}H	87	^{137}Cs	40
^{131}I	5	^{3}H	24
^{41}Ar	2	^{60}Co	13
^{135}Xe	1	^{110m}Ag	10

Considering all discharges, tritium (^{3}H) was found to contribute approximately 41% of the total dose to members of the public from Koeberg radiological effluent discharges in 1997.

Radioactive Waste Management

The radioactive waste generation figures relating to 1997 are shown in Table 3. Generation of solid radioactive waste amounted to 129 m^3 drummed in metal drums and 188 m^3 drummed in concrete drums.

Table 3

INVENTORY OF SOLID RADIOACTIVE WASTE DRUMMED IN VARIOUS TYPES OF DRUMS IN 1997	
Type Of Solid Radioactive Waste	No. Of Drums y^{-1}
C_1 drums containing NCW	6
C_1 drums containing concentrates	46
C_1 drums containing resin	16
C_2 drums containing resin	35
C_2 drums containing concentrates	0
C_4 drums containing filters	5
C_{2F} drums containing filters	12
210 litre drums containing general trash	440
210 litre drums containing resin	126

The shipment of radioactive waste to Vaalputs in 1997 involved 960 metal drums, approximating to $200m^3$ of waste.

Environmental Surveillance

In order to provide an assurance that adequate control has been maintained over effluent discharges, and to monitor for any unexpected accumulation of radioactive contaminants in the environment, an environmental monitoring programme is carried out. A variety of environmental media including vegetation, soil, sewage and marine life around Koeberg is routinely sampled and analysed for radioactivity. Representative samples from all possible pathways to the public are analysed through extremely sensitive radio-analytical methods in the laboratory. The sensitivity of the analytical methods is demonstrated by the fact that natural radioactivity can be detected in most samples. Samples of seawater and drinking water have been analysed for tritium. The results show that the relatively small amounts of tritium released from Koeberg is masked by the tritium naturally present in environmental waters. Very small amounts of radionuclides, for example ^{110m}Ag, that originate from the operations at Koeberg were occasionally found in some marine samples.



A fish being analysed for radioactivity.



The Deputy Mayor of Cape Town and some of the VIP's who attended the 1997 Emergency Exercise in Cape Town

In addition to continuous monitoring of radioactivity in effluent, radiation levels within the environment are monitored by means of an extensive network around Koeberg. The programme makes use of thermoluminescent (TLD) radiation monitoring devices. Analysis of the TLD data did not indicate any increase in background radiation levels. The environmental surveillance programme, which is conducted according to international standards, provides an independent verification that adequate control is exercised over effluent discharge.

Feedback from Operational Occurrences

A system of occurrence identification, recording, reporting and root cause analysis is required by condition of licence. Two particular occurrences of significance were reported during the year, both of which involved unplanned exposures of workers. In the first, during Outage 208, three workers made an unauthorised entry to a room in the reactor building. The resulting doses were below the annual limits and corrective actions have been implemented to prevent recurrence.

In the second occurrence, workers received unplanned exposures during a routine filter change operation. Three workers were exposed to high levels of external radiation, two of which were in excess of the annual dose limits prescribed by the CNS. The CNS initiated a formal inquiry that revealed a number of deficiencies in training and operational feedback. Corrective actions to prevent recurrence were established and implemented.

Emergency Preparedness

It remains a condition of the Koeberg licence that a comprehensive emergency plan be maintained for Koeberg. The CNS is committed to ensuring that the plan is in a state of

continual readiness to recognise and respond to any accident with potential for both on and off-site consequences. An ongoing programme of training, auditing and exercising maintains the preparedness of Koeberg and the off-site local authorities to respond to accidents. An essential component of assuring the CNS of the effectiveness of these arrangements is the major demonstration exercise conducted approximately every eighteen months.

A full-scale emergency plan exercise was held in October 1997 involving both on and off-site organisations. The exercise scenario involved a simulated reactor core melt accident followed by containment building integrity failure leading to a release of radioactivity into the environment. The emergency organisation simulated the implementation of the protective actions that were expected of them, including the evacuation of Atlantis and Table View. The exercise was to have been performed in two parts - the first relating to the testing of the early phase response and the second relating to the testing of the late phase response. However, discussions revealed that the exercising of later phase emergency response provisions was not tenable owing to the lack of a formalised disaster management strategy at the provincial level.

The purpose of the exercise was to identify any deficiencies or shortcomings in the emergency plan and to effect measures for improvements in these areas. Examples of areas that were examined are the performance of personnel and the response of off-site authorities. Various issues, in particular the timely implementation of protective actions and the evacuation of mass care centres were identified. Corrective actions to address these issues are being implemented. Nevertheless, the exercise was successful in demonstrating that the main objective of the Koeberg Emergency Plan, namely the protection of the public by timely protective action decision-making, was adequate. As part of the CNS policy of maintaining links with the international arena, representatives of various countries were invited to observe the exercise.

Emergency Planning Liaison

In view of the number of organisations involved in the Koeberg emergency plan, it is vital that adequate liaison be maintained at all times. The Emergency Planning Liaison Committee provides a forum to address all aspects of the emergency plan. The meeting also serves as a vehicle to inform local authorities and all interested parties of national and international developments concerning emergency planning and to maintain public confidence in the regulatory process undertaken by the CNS. During the year under review, three Emergency Planning Liaison Committee meetings were conducted under the chair of the CNS. Members representing the various local authorities and other interested parties involved in the Koeberg Emergency Plan attended the meetings.

During 1997, a new forum was convened by the CNS with the formation of the Koeberg and Environs Development Committee (KEDC). This has provided a much-needed platform for the dissemination of information, discussion and evaluation of ideas with the local planning authorities. It has facilitated the formulation of processes to address development issues around the Koeberg site.

Involvement of local authorities, consultative bodies and other affected parties in the re-examination and re-affirmation of planning bases, development decisions and demands for rezoning has been achieved through the KEDC.

It has enabled the CNS to explain and discuss the Koeberg emergency plan philosophy, policy and rationale for restricting certain developments around Koeberg with those charged with the responsibility for planning and development decisions.

Work has progressed through the KEDC in the evaluation of alternative planning scenarios and population densities for the Koeberg environs. The object has been to achieve reasonable solutions based on the recognition of social and economic pressures in the area and the need to respect internationally based norms and regulatory restrictions on land use around nuclear power station sites.

To this end the CNS has made several presentations to major decision makers at local and national government level on the philosophy, policy and practical considerations of emergency planning, regulatory control and risk assessment associated with nuclear installations and development issues.

PEBBLE BED MODULAR REACTOR

In terms of considering options for the future generation of electricity, Eskom has continued to investigate various technologies. Included in this range of technologies are differing types and designs of nuclear power stations. In recent years these investigations have revealed that power stations based on the modular, high temperature, gas-cooled, direct gas turbine cycle design could have significant economic and generating advantages. The economics of such a power station critically depend on the design requirements necessary to provide the required level of nuclear, radiation and waste safety. In order, therefore, for Eskom to pursue its feasibility studies, it has engaged in dialogue with the CNS concerning the process to be undertaken to determine the necessary design basis from a safety point of view and to evaluate a proposed design to determine if it could be licensed. The proposal under consideration by Eskom is based on a design developed and tested in Germany. It makes use of a so-called pebble bed reactor core in which the fuel is made of coated ceramic micro-spheres of uranium oxide contained in graphite spheres about the size of a cricket ball.

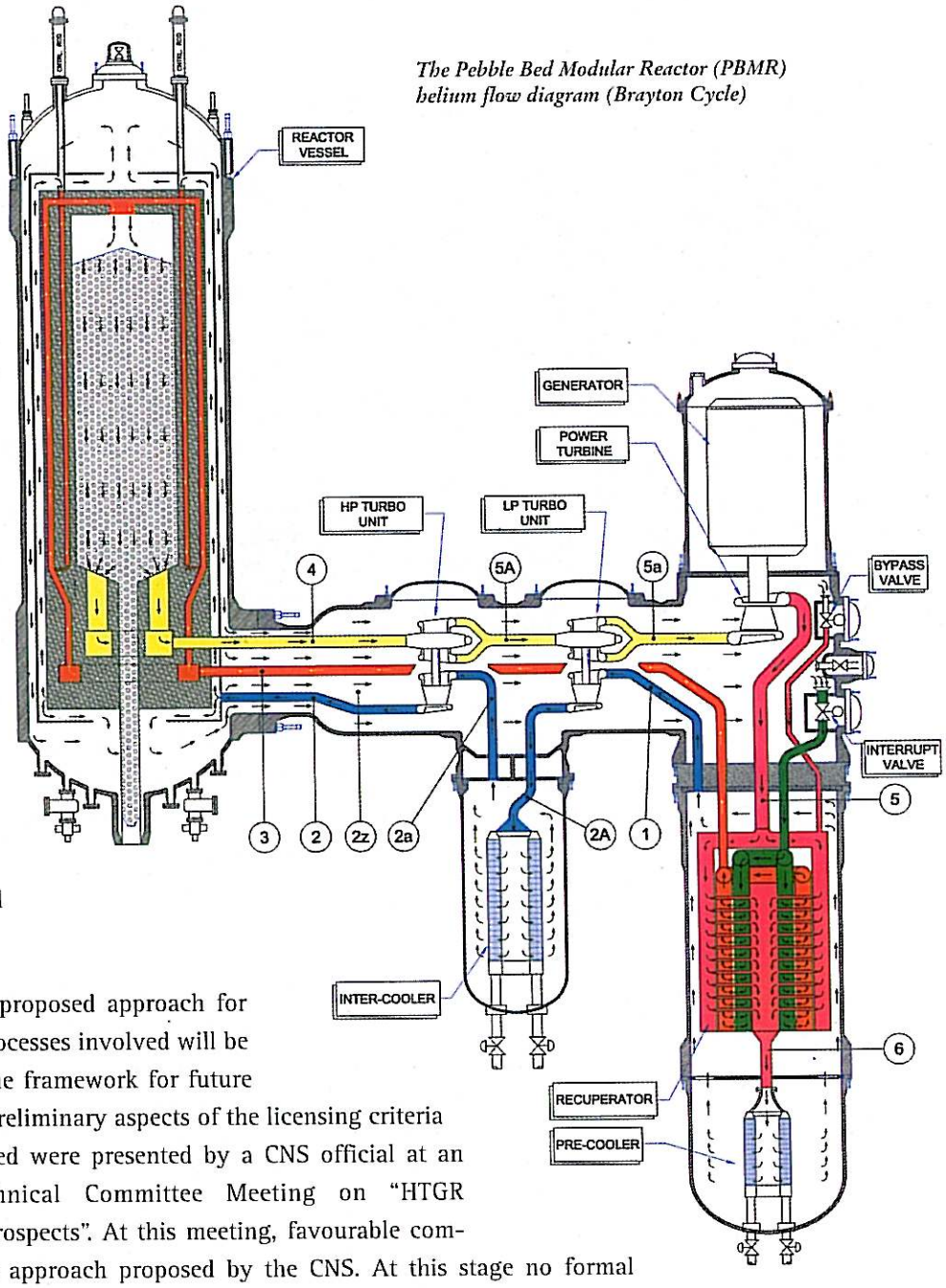
SAFETY ASSESSMENT

With a view to initiating the licensing procedure, Eskom provided a technical description of the Pebble Bed Modular Reactor (PBMR) concept to the CNS based on High Temperature Gas Cooled Reactor (HTGR) designs developed overseas. As a result of extensive interactions with Eskom, and internally within the CNS, it was recognised that in order to undertake the envisaged licensing work associated with this type of reactor and to develop a credible licensing process, staff expansion and development of in-house expertise would be necessary. Particular aspects of the project where development of expertise would be

required were identified as; the high temperature operating environment of the core, gas cooling, graphite technology and fuel manufacture.

The CNS investigated the possibility of engaging specialised consultant services from overseas organisations experienced in HTGR reactor technology. Two CNS officials visited various overseas organisations, selected on the basis of advice solicited from contacts overseas and the involvement which the CNS has had to date with the International Atomic Energy Agency Working Group on High Temperature Gas Cooled Reactors.

The Pebble Bed Modular Reactor (PBMR) helium flow diagram (Brayton Cycle)



The CNS has developed a proposed approach for licensing the PBMR. The processes involved will be finalised and adopted as the framework for future licensing activities. Some preliminary aspects of the licensing criteria and approach to be adopted were presented by a CNS official at an international IAEA Technical Committee Meeting on "HTGR Applications and Future Prospects". At this meeting, favourable comment was received on the approach proposed by the CNS. At this stage no formal licence application has been made to the CNS in terms of the Nuclear Energy Act. All the licensing work undertaken by the CNS is in anticipation of a future application by Eskom.

NUCLEAR POWER STATION SITING

Cape St Francis Site

A structure plan for the vicinity of the Cape St Francis site has been submitted to the CNS for assessment with a view to the site remaining viable for possible future construction of a nuclear power station. This was assessed and found to be acceptable.

VAALPUTS NATIONAL RADIOACTIVE WASTE REPOSITORY



The Vaalputs National Radioactive Waste Repository

SAFETY ASSESSMENT

The Vaalputs nuclear licence was varied twice during the reporting period to allow the reformatting of the main conditions as well as the inclusion of fourteen licence documents specifying radiation protection requirements.

Following the moratorium placed on the receipt of waste at Vaalputs in 1996 and the CNS' subsequent inspections and acceptance of corrective actions, shipping of waste from Koeberg to Vaalputs recommenced in December 1997 and a total number of 960 metal drums (low level waste) were received from Koeberg.

COMPLIANCE ASSURANCE

An occurrence relating to the cracking of concrete waste drums and the leaching out of small quantities of radioactivity into the disposal trenches was reported during 1997. This appears to have been caused, in part, by the exposure of the waste drums and subsequent weathering due to the action of sun, wind and rain. AEC and CNS surveys have indicated that no spread of contamination outside the trenches has occurred. A possible contributory factor has been identified as the filling technique used at Koeberg. In consequence, the manufacturing specification and procedure for filling of concrete drums at Koeberg is still under investigation. Long exposure of waste drums to the action of the elements at Vaalputs is a recognised problem and in this regard the AEC is preparing a submission on the capping of the two trenches which will prevent the future exposure of the drums to the weather.

SAFETY INDICATORS

Environmental Monitoring

With regard to the radiological impact of Vaalputs on the environment, the 1997 AEC surveillance report indicated that, with the exception of naturally occurring radionuclides, no radioactivity was detectable in the environment. This was confirmed by the CNS' independent verification programme of sampling and analysis of the environment.

ATOMIC ENERGY CORPORATION - PELINDABA SITE



The Pelindaba site of the Atomic Energy Corporation.

The Pelindaba site is situated near Hartebeespoort dam, some 30 km west of Pretoria. Apart from various chemical and industrial facilities, the AEC operates a range of nuclear and radiation technology related facilities. The 20 MW Safari Research and Isotope Production Reactor is one of the major facilities and has various applications. Uranium target plates are irradiated for molybdenum production (~250 plates per annum), neutron transmutation doped silicon for semiconductor applications (~2.5 tonnes per annum) is manufactured and general radiation services involving approximately fifteen hundred sample irradiations are conducted per year. Training of students from various academic institutions is also conducted. The Safari Reactor is supported by the Uchem and Elprod facilities responsible for the production of highly enriched uranium (HEU) alloy billets and reactor fuel fabrication respectively. The Hot Cell Complex receives irradiated uranium plates from Safari which are dissolved for the extraction of molybdenum and iodine isotopes which are sold on the international market. The Isotope Centre produces medical isotopes whilst the Lumitec facility manufactures radioluminescent light sources.

Several laboratories provide radioanalytical services and the Biogam irradiation facility is used for food irradiation to improve the shelf life of various foodstuffs. Various facilities are involved in decontamination and waste management including the Thabana Pipe Store for spent fuel from the Safari Reactor. Several facilities are being dismantled and decontaminated whilst others have been placed in care and maintenance pending dismantling.

SAFETY ASSESSMENT

All the nuclear and radiation technology related facilities are required by condition of licence to have an approved plant description and risk assessment in place. These facilities are required to be operated in accordance with approved documentation relating to plant operations, in-service inspection, maintenance, security, and radiation protection.

During the reporting period, the nuclear licence for the site (NL-27) was varied twice to make provision for the receipt and storage of depleted uranium metal and for the inclusion of various licence documents on radiation protection, radioactive waste, criticality and radioactive gaseous and liquid effluent.

Assessed Submissions

A summary of the submissions assessed in 1997 by the CNS is provided in Table 4. A major project aimed at consolidating the radiation protection standards was completed with the revision and approval of these standards. Incorporated in these were the Criticality Prevention and ALARA programmes. The Council also approved revised Annual Authorised Discharge Quantities for the release of gaseous and liquid effluent from the Pelindaba site. Standards on classification and characterisation of radioactive waste, incorporating the most recent recommendations from the IAEA, were also approved. A major milestone was reached with the approval and commissioning of the Thabana Pipe Storage Facility to receive and store spent fuel elements from SAFARI. The Metox Zirconia Beneficiation Plant was also licensed during this period.

Table 4

AEC SUBMISSIONS ASSESSED BY THE CNS 1997	
Safety Assessments	38
Facility Operating Technical Specifications	6
Facility Quality Management Manuals	5
Facility In-service Inspection Manuals	1
Facility Security Manuals	10
Radiation Protection Standards	8
Waste Management Manual	1
Radioactive Effluent Standard	1
Total	70

Safari Safety Reassessment

The AEC submitted a draft of chapter 16 of the Safari-1 Safety Analysis Report (SAR) on accident analysis. The analyses were performed using the RELAP-5 code. The submission is under review by the CNS. It was proposed that the analyses performed be used for the risk assessment and the identification of a definitive deterministic basis for set-point determination and the operating technical specifications.

Annual Authorised Discharge Quantities (AADQ's)

A licence change request for revised AADQ's was submitted for which the CNS, using computer modelling, assessed the airborne pathway. The assessment identified a number of areas where revision was necessary and the AEC submission will be corrected accordingly and resubmitted to the CNS.

Presentation On Operating Technical Specification Requirements

A presentation was made to AEC facility managers on the CNS requirements for the development of operating technical specifications with a view to clarifying intent and structure.

Thabana Waste Storage Facility

A safety submission on the operation of the waste storage facility, Thabana, was submitted by the AEC and reviewed by the CNS. The submission was not accepted in view of its not specifically addressing the requirements of the CNS.

COMPLIANCE ASSURANCE

During the year, the CNS conducted one hundred and ninety five licence compliance inspections, visiting each nuclear facility at least once. Compliance inspections were carried out against the various licence requirements and also included CNS participation in the AEC internal licence compliance and quality audit programmes. Issues of non-compliance identified during inspections were taken up in the corrective action programme required by the licence.

Environmental Surveillance

The potential exposure pathways associated with radioactive effluent discharged from normal operations at the Pelindaba site are through liquid effluent releases to the Crocodile River and gaseous releases from the various facility stacks. With a view to ensuring adequate control over these effluent discharges, analyses for total radioactivity as well as for specific radionuclides were routinely performed on various environmental media. These included water samples taken from the river and from the nearby Hartebeespoort Dam, soil, vegetation, milk and agricultural products, direct radiation measurements and measurements of any deposited activity. Levels of radioactivity in all samples were below CNS reporting levels. With the exception of the naturally occurring radionuclides, all measurements were below the detection limits of the analytical instruments. The CNS also conducted an independent verification of the AEC's environmental monitoring programme and confirmed that there was no contamination of the environment around the Pelindaba site.

SAFETY INDICATORS

Public Exposure Due To Radioactive Gaseous and Liquid Effluent Discharges

The activity in liquid and gaseous effluent discharges from the Pelindaba site for the period April 1997 to March 1998 was 14,01 GBq which is 56% of the Annual Authorised

Discharge Quantity (AADQ). A summary of the gaseous effluent management data for 1997 is provided in Table 5.

Table 5

AEC GASEOUS EFFLUENT MANAGEMENT DATA 1997		
Gaseous Discharge Type	% Of The AADQ Discharged In 1997	Public Dose Due To Discharge In 1997 [µSv]
Uranium	23.7	4.9 E-01
Alpha Activity as ^{239}Pu	1.8	1.7 E-03
Beta Activity as ^{90}Sr	0.6	1.0 E-03
Iodine Activity as ^{131}I	45.00	7.2 E+00
Noble Gas as ^{85}Kr	1.2	1.9 E-02
Tritium	0.3	3.3 E+00
Total		7.7

The estimated annual dose to the public from activity discharged in liquid releases is 41 µSv. The total estimated maximum dose to a member of the public from atmospheric and aquatic pathways at the Pelindaba site is 48 µSv which is 19.5% of the site public dose limit of 250 µSv per year.

Occupational Exposure

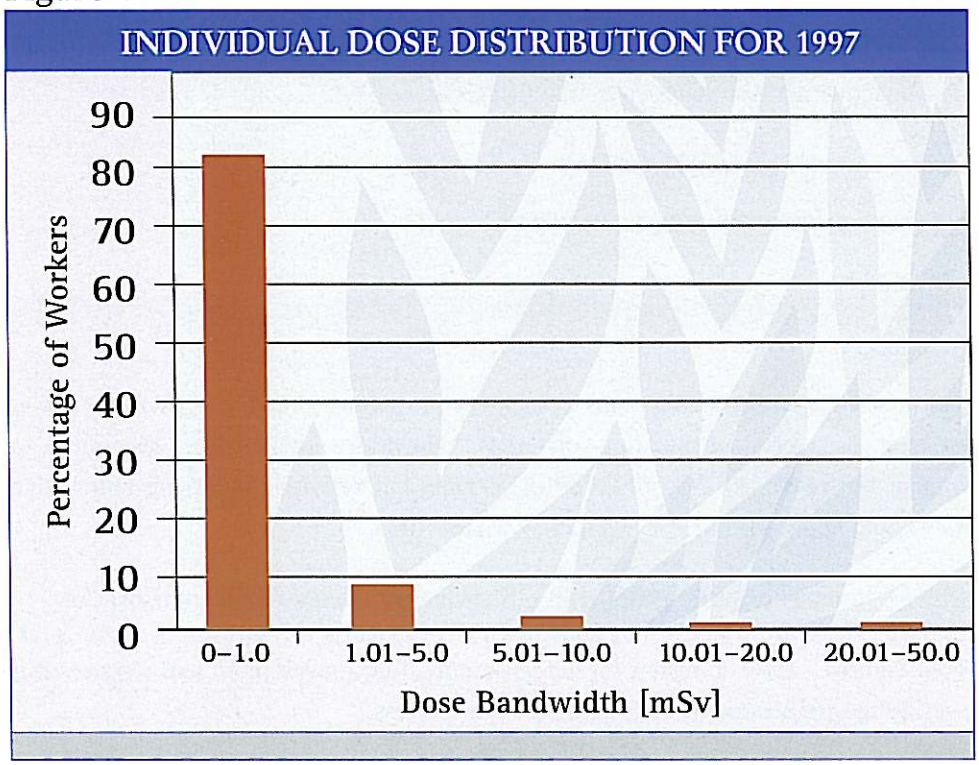
The distribution of occupational exposures at the AEC is provided in Table 6 below.

Table 6

AEC OCCUPATIONAL EXPOSURE STATISTICS 1997	
Dose Interval [mSv]	Percentage Of The Occupationally Exposed Workforce With Annual Dose In Dose Interval
0 – 1	86.10
1.01 – 5	11.40
5.01 – 10	2.20
10.01 – 20	0.36
20.01 – 50	0.00

The distribution of individual dose is presented graphically in Figure 4.

Figure 4



The number of workers who were occupationally exposed to radiation for the period 1 April 1997 to 31 March 1998 was 1151 and the collective dose received by the workforce was 403 person-mSv.

Compliance with Dose Limitation Requirements

The maximum dose received by any individual in 1997 was 16 mSv. Approximately 99.7 % of the occupationally exposed population received annual doses that were less than 10 mSv and all exposures were well within the annual dose limit of 50 mSv.

The annual average individual dose for the occupationally exposed population was 0.35 mSv for 1997 which is well within the ALARA objective of 10 mSv.

Radioactive Waste

With radioactive waste quantification and disposal still under consideration, wastes have been managed by interim storage at the various Pelindaba facilities. No waste drums have been compacted during this period whilst 66 containers of short-lived radioactive waste from the molybdenum production process, amounting to 1.84 m^3 of waste, were received by the nuclear waste management services. Short-lived radioactive waste received from hospitals, research institutes and universities amounted to 303 containers, approximating to 30 m^3 of waste.

MINING AND MINERALS PROCESSING

During the reporting period, two more licences were granted to mining and minerals processing facilities, whilst one facility surrendered its licence. At the end of the reporting period, the number of mining and minerals processing facilities and users of small quantities of radioactive material licensed by the CNS was:

Mining and minerals processing facilities	53
Users of small quantities of radioactive material	23
Scrap re-cyclers	7
Total	83

The CNS proceeded with investigations at facilities processing zircon, coal-burning power stations and producers of building materials, which are radioactive. According to Government Notice No. R. 849, all facilities carrying out activities involving radioactive material should apply for nuclear licences by March 1999.

Declarations, in terms of section 51(b)(1)(i) of the Nuclear Energy Act, were issued to:

- Avgold Limited - E.T.C. Division for demolishing an old roaster plant and reprocessing the resulting bricks through their gold recovery process.
- RMP Properties (Pty) Ltd for establishing the Crown City industrial township.

SAFETY ASSESSMENT

Since commencing application of regulatory control over radiation hazards associated with the mining and processing of radioactive ores and minerals, considerable development work has been conducted to identify all the sources of such hazards and quantify their magnitude. This work has entailed the establishment of appropriate methodologies, in consultation with the industries concerned, and systematic application of these established methodologies. These efforts have been directed within two areas, namely those of exposure of the workers engaged in the various activities (occupational exposure) and to members of the public. Exposure to the latter can arise through effluent discharges, waste disposal practice, releasing radioactively contaminated materials into the public domain, use of contaminated land and the transport of radioactive materials in public areas.

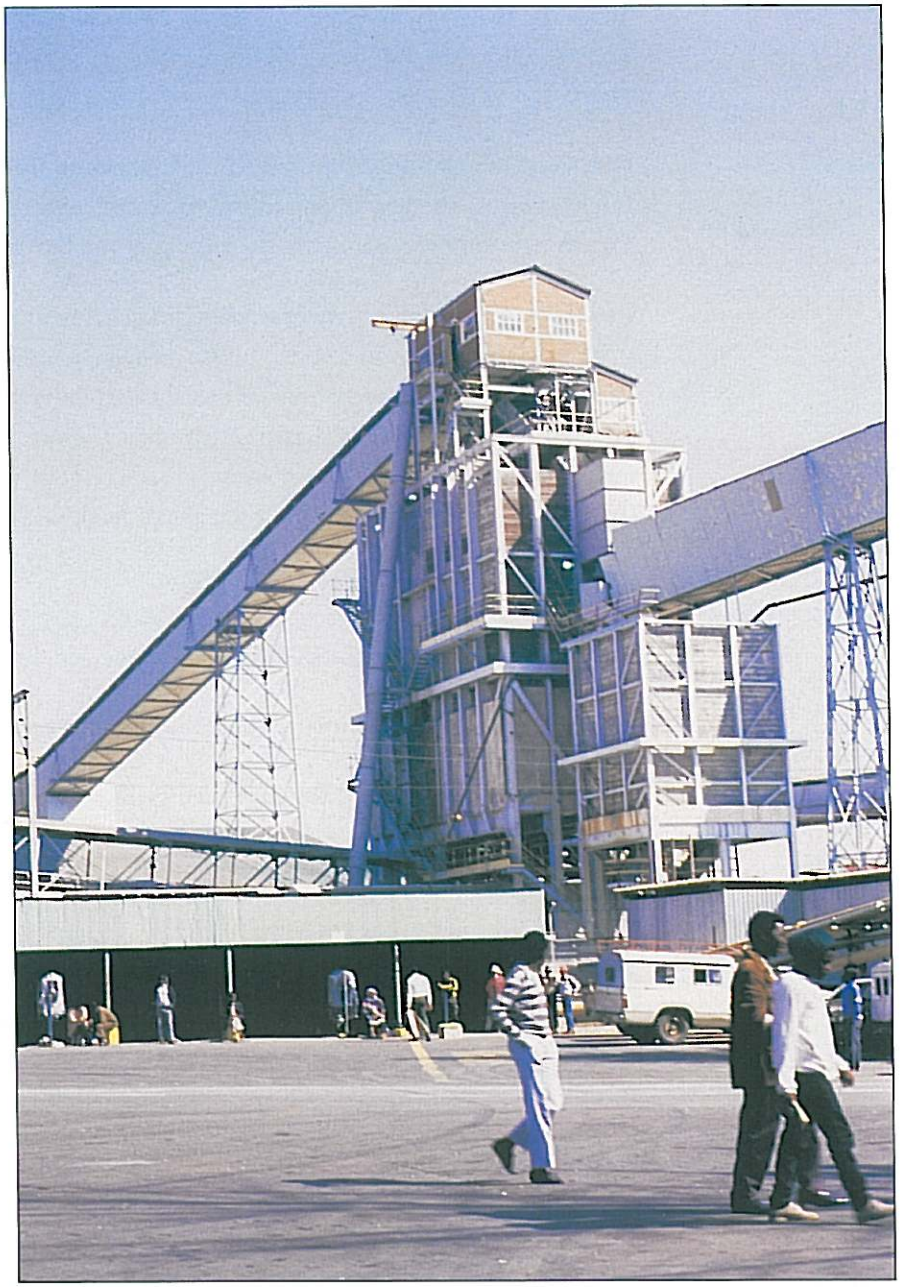
Control Of Public Exposure To Radiation

To determine the control measures, which are necessary to protect members of the public against radiation hazards, a hazard assessment must first be conducted. Extensive dialogue has been undertaken with the specialists and consultants representing licensees in the determination of methodology to be applied. All licensee assessments are scheduled for completion by December 1998. Licensees have submitted project plans presenting proposals for the conduct of their assessments.

To ensure that these assessments are both adequate and completed on time the CNS established an inspection programme to review progress with licensee assessments, inspect compliance with project plans and to evaluate assessment results.

In the field of waste management, licensed scrap re-cyclers have made submissions to satisfy CNS requirements in this regard. These requirements were finalised during the previous reporting period and were based on various studies and investigations. Final approval of all the submissions is expected before the end of 1998.

It was reported by licensed scrap processors that 73 485 tons of scrap metal from licensed mining and minerals processing facilities, were melted.



Western Deep Levels mine shaft.

One hundred and fifty three consignments of ammonium diuranate were received by Nufcor from licensed mining and minerals processing facilities, whilst seven consignments of U3O8 were dispatched from Nufcor for export. These figures are lower than those reported for the calendar year 1996, owing to closure of certain uranium plants during the course of the year.

Protection of workers

As with the protection of the public against radiation hazards, the steps in establishing protection of workers also require a hazard assessment to be conducted. Based on the hazard assessment, a radiation protection programme must be established. Such programmes must include a radiation monitoring programme, which must demonstrate that doses to individual workers are maintained as low as reasonably achievable and are below dose limits.

To ensure that these assessments are adequate and completed on time, an inspection programme to review progress with the assessment, inspect compliance with assessment proposals and to evaluate the assessment results has been conducted.

Considerable progress has been made in completing the assessment of radiation hazards to the workforce. The percentage of the workforce covered by assessments submitted to the CNS increased from approximately 30% to around 80% during the reporting period.

During the year emphasis was placed on monitoring programmes to demonstrate that doses were maintained as low as reasonably achievable and below the specified dose limits. Since the monitoring of individual doses could be very costly, the CNS has accepted the principle that statistically based programmes could be used. Licensees are, however, required to quantify the relative error in assessment of the dose. Technical problems in this regard were also discussed during the above-mentioned project team meetings.

COMPLIANCE ASSURANCE

Throughout the reporting period the CNS conducted a series of inspections focussing on;

- Maintenance and demolition of plants which process or processed radioactive material.
- The release of equipment from licensed facilities as scrap or for repair.
- The implementation of control programmes at licensees where dose limits could be exceeded.

Fifteen audits were also conducted to determine the degree to which quality management programmes were implemented. Harmony Gold Mine was found to be in violation of licence conditions as regards removal of scrap from the site. This operation was temporally closed down until the CNS was satisfied with the undertakings of the mine in terms of controls on scrap removal. Only a few minor findings were made against several other mines.

The quality management programmes of ten licensees were reviewed with the quality level of the submitted documents varying from acceptable to totally unacceptable.

SAFETY INDICATORS

Occupational Exposure

In general, licensees calculate the doses using area measurement results and making the conservative assumption that workers spend their whole working year (2 000 hours) at a measurement location.

From licensee reports it is clear that a significant number of underground workers could exceed the dose limits. In terms of implementing control programmes and associated monitoring programmes, the focus was on those licensees where dose limits could be exceeded.

An example of such a licensee is Harmony Gold Mine. Their 1997 annual dose report indicated that approximately one thousand persons were exceeding dose limits laid down by the CNS. In some instances such limits are exceeded by as much as five times (the CNS dose limits correspond to an internationally accepted norm).

The CNS informed the Minister of Minerals and Energy about the situation and also convened meetings with management and labour representatives of Harmony Gold Mine to discuss the matter. As a result it has been agreed that the CNS, management and labour representatives would be meeting on a regular basis to review progress with the actions that have been taken to reduce dose levels, review the monitoring results and resolve technical issues.

Occurrences

During the year a number of occurrences were reported of which all but one were closed after acceptable corrective actions were identified and implemented. Of those reported during the year (148) only three percent were classified as Level 1 (most serious), whilst fifty five percent were classified as Level 2 and forty two percent as Level 3, the latter being of minor safety significance. The level 1 and 2 occurrences related mainly to non-compliance with specified licence requirements. The Level 1 occurrences concerned breaches of radioactive waste management procedures and did not involve significant exposure to radiation of any workers or members of the public.

Sale Of Contaminated Equipment In The Free State

An incident arose in which Harmony Gold Mine sold two contaminated tanks to an engineering company in Virginia. Fortunately, one tank was sold to the licensed Oryx Gold Mine where the contamination was detected. The CNS investigation at the engineering company indicated a minor spread of contamination. Harmony Gold Mine collected the tanks and the residual contamination, which was removed and packaged at the engineering company, for safe storage. The tanks appear to have been removed from the uranium plant prior to licensing and measures were put in place to prevent similar occurrences.

Theft Of Contaminated Pipes At Stilfontein

Stilfontein Gold Mine stores highly contaminated pipes in a temporary store at the redundant Chemwes uranium plant. Despite the steps taken by the licensee to secure the pipes, some of the pipes were stolen and transported to Bafana Bafana Scrap Yard in Stilfontein for processing. The pipes were only discovered at this site after they had been cut. During an investigation, the CNS discovered widespread contamination of the site and of personnel who were involved in the cutting.

Stilfontein Gold Mine cleaned the site of Bafana Bafana Scrap Yard. Biological samples of workers that were involved in the cutting operations at the scrap yard had been analysed to determine whether an uptake of uranium has taken place. No significant levels of internal contamination were detected.

Rehabilitation of Contaminated Off-Mine Sites

Owing to no resolution being achieved on the problem of storage and disposal of radioactive waste from off-mine sites, no further progress took place regarding the clean-up of the off-mine sites where the handling, storing and processing of contaminated materials from mines has resulted in contamination. Following an approach to the government in this regard, the matter remained under consideration by the Department of Minerals and Energy in consultation with the AEC and the CNS.

SUPPORTING ACTIVITIES

LEGISLATION

The process of revising the Nuclear Energy Act, which was commenced by the CNS, has been taken over by the Department of Minerals and Energy and the CNS will make the necessary input when requested.

NATIONAL RADIOACTIVE WASTE MANAGEMENT POLICY

The process of establishing a national radioactive waste management policy is under review in terms of the Integrated Pollution Control policy being developed by the Department of Environment and Tourism in consultation with interested and affected parties. The CNS is maintaining an involvement with the process and has proposed that the internationally endorsed principles of radioactive waste management and regulatory control developed by the International Atomic Energy Agency be used as a basis for national policy in respect of radioactive waste management.



Adv. Mojanku Gumbi, the Deputy President's Legal Advisor, with CNS staff.



From left to right: Prof John Martin (CNS Chairman), Mr Lars Högberg, Director-General of the Swedish Nuclear Power Inspectorate (SKI) and Mr Bert Winkler (EO - CNS).

EXTERNAL LIAISON

The CNS maintained an active external liaison function throughout the reporting period. The thrust of the programme has been to develop and maintain an awareness of matters related to nuclear, radiation and radioactive waste safety amongst all interested and affected parties including schoolchildren, specialists in various disciplines, representatives of workers occupationally exposed to radiation and public representatives and officials. Of particular note during the year was the publication of the first in a series of CNS information posters aimed at radiation workers at mines, the public in general and students in particular.

Highlights of the year included the CNS Annual Lecture presented by the Director-General of the Swedish Nuclear Power Inspectorate, Mr Lars Hogberg, on "Nuclear Safety and Waste Safety Aspects of a Twelve Reactor Nuclear Programme".

Also the Nuclear Discovery School Project, which was initiated and organised as the CNS contribution towards the National Year of Science and Technology, proved to be very popular. Approximately three hundred schools from the nine provinces elected to participate in this event, which will culminate in a prize-giving ceremony to be held later in 1998.

The CNS developed and maintained contact with a number of nuclear regulatory authorities throughout the world and has formal exchange and co-operation agreements with authorities in the USA, UK, France, Canada, and Argentina.

SUPPORTING ACTIVITIES
(continued)

The CNS is actively involved in training and education initiatives at both the national and African regional level. The CNS provides guidance to licensees on the staffing of their radiation protection function. Related to this the CNS established a system to recognise formally Radiation Protection Officers (RPO's) who are responsible for the implementation of radiation protection programmes at licensed facilities. A number of RPO's received such recognition during the year.

Support has been provided to the University of the Northwest in the establishment of a Masters Degree course in Radiation Science and Technology and to the University of the Witwatersrand in the establishment of a Radiation Safety Training Centre. This centre is being established with the support and sponsorship of the International Atomic Energy Agency and will provide training to South African students as well as those from the African regions by the IAEA.

The CNS has also been instrumental in running three regional training courses for the International Atomic Energy Agency in various aspects of radiation safety.

As part of its technical co-operation activities, the IAEA sponsors persons from developing countries to spend time with host institutions in other countries to gain practical experience in their particular disciplines. Since 1996 the CNS was the host institution for six fellows and one scientific visitor, for whom suitable training programmes were arranged under the IAEA Technical Co-operation Programme. In the reporting year, two IAEA fellows received training at the CNS in Upgrading Of The Radiation Protection Infrastructure.



Melt Marais of Stilfontein Gold Mine receives his Radiation Protection Officer (RPO) certificate.

This included the organisation of discussion sessions with South African radiation protection experts on the issues of duties of regulatory bodies and licensees, familiarisation with new developments in radiation protection philosophy and regulation, regulatory aspects associated with sources and practices and licensing procedures. The training also involved several visits to other institutions, namely the South African Bureau of Standards, Council for Scientific and Industrial Research, Atomic Energy Corporation, Koeberg Nuclear Power Station, and the National Accelerator Centre, where the trainees acquired specific knowledge relating to their individual training programmes. Feedback to the CNS, from both the IAEA and the trainees themselves, has indicated a high regard for the quality of the training.

CNS Conference On Risk

The CNS conference entitled "Exploring the Application of Quantitative Risk Assessment" was held during 20-22 August 1997. The objective was to establish consistent interlocking regulations and standards on a national basis. The conference was well supported by the industry and consultants, but generally not by government regulators.

INTERNATIONAL CONVENTIONS

The CNS maintained an active involvement in preparatory meetings for implementation of the Convention on Nuclear Safety. At the national level, the process for drafting the first country report required in terms of the convention was completed and work has commenced on drafting the report. The first report must be submitted to the convention secretariat, the IAEA, by September 1998.

The Joint International Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management was adopted by a diplomatic conference convened in Vienna during September 1997. The convention is seen to be complementary to the Nuclear Safety Convention and is also an incentive convention. It requires contracting parties to comply with international standards of safety, to control the trans-boundary movement of spent fuel and radioactive waste and to periodically report on compliance. A recommendation has been made to the Minister of Minerals and Energy that South Africa sign and ratify the convention.

INTERNATIONAL PARTICIPATION

NRC Agreements

The CNS has entered into a co-operation agreement with the United States Nuclear Regulatory Commission in the following areas of nuclear regulatory research.

- Relap-5 Code Application and Maintenance Programme (CAMP) for five years.
- Co-operative Severe Accident Research Programme (CSARP) for three years.
- PRA International Research Programme (COOPRA) for five years.

On the COOPRA programme, three international working groups are being established on various areas of risk assessment.

During the reporting period, CNS staff attended various seminars and participated in various international meetings and technical visits.



The Minister of Minerals & Energy, Dr Penuell Maduna, with the Chairman of the US NRC Dr Shirley Jackson and a member of the delegation.

PERSONNEL

TRAINING

CNS Auditors Training Programme

The CNS auditors training programme is on schedule. All CNS technical personnel, who are involved as technical experts in the audit teams, are required to undertake the full auditors training course without the necessity of having to qualify as auditors.

Technology Transfer To CNS

In terms of the technology transfer agreement between the CNS and Pulles, Howard and De Lange, Senes Consultants (Toronto, Canada) and Brenk Systemplanung (Aachen, Germany), two members of the CNS staff received training in Germany in March 1997 on the modelling of environmental impact due to mining and minerals processing facilities.

Human Resources

The CNS continued its efforts to maintain its complement of highly qualified and experienced staff, in order to ensure a service to licensees and the public of the highest level, and to be comparable with international standards.

Although the staff turnover remained low, the CNS had to fill a number of vacancies owing to retirements and resignations. This was achieved with due consideration to the CNS' commitment to redress the imbalances of the past. Good progress was made during the year with the development of an affirmative action policy through a consultative process including all levels of staff within the CNS.

The CNS progressed satisfactorily with its bursary scheme, meeting its target of granting bursaries to five students, mainly in the Engineering and Radiation Protection disciplines.

ADMINISTRATION AND INFORMATION TECHNOLOGY

Information Technology

The CNS commenced with the development of its Y2K compliance programme. This programme is designed to identify computer hardware and software which is non-compliant with Y2K requirements, and to replace these with appropriately qualified items.

Finance

The income from licensees in the Mining and Minerals Processing sector and the Atomic Energy Corporation was less than projected. The CNS was also not able to increase the funding it receives from state funds from 20 percent of its total income budget, to the agreed 30 percent. Notwithstanding these factors the increase in licence fees was maintained within CPI guidelines.

NATURE OF BUSINESS

The Council for Nuclear Safety (CNS) was established in terms of Section 33 of the Nuclear Energy Act, 1993 (Act No. 131 of 1993) to safeguard persons against nuclear damage by regulating and exercising control over -

a) the construction or use of a nuclear installation ;
b) the use, possession, production, storage, processing, enriching, reprocessing, conveyance or disposal of radioactive material ;
c) the discarding of radioactive waste ;
d) the storage of irradiated nuclear fuel ;
e) the carrying out of any other activity involving radioactive material and which is capable of causing nuclear damage.

In achieving its aim, the main functions of the CNS are to grant licences (or issue declarations) with attendant conditions for the above activities and to advise the Minister on any matter associated with these, to act as the national competent authority in terms of the IAEA's Regulations for the Safe Transport of Radioactive Material and to assist in the provision of a purposeful educational and training environment in matters of nuclear safety supported by the dissemination of pertinent information.

STATE OF AFFAIRS

The exercise of responsible and effective regulatory control is a cornerstone of CNS strategy. Its regulatory practices, comparable internationally, address the risk of nuclear damage through the application of quantitative and qualitative assessment techniques and safety assurance programmes in a cost effective manner.

In implementing its mandate, the CNS has continued to be consistent with broad Government policy in respect of health and safety and financial administration.

At year end the CNS had a total of 87 licensees (1997 : 86 licensees), covering the mining and minerals and nuclear energy sectors, and including incidental users of radioactive materials from the nuclear fuel cycle.

Through monitoring compliance with conditions of licence and ensuring that appropriate steps were taken by licensees to improve nuclear safety activities and practices, where necessary, the CNS remained in a position to provide assurance of nuclear safety on a national basis.

OPERATING RESULTS AND FINANCIAL POSITION

The financial statements set out the operating results for the year. Income amounted to R28,296m (1997 : R26,615m) of which the contribution to expenditure by the State amounted to R5,4m (1997 : R5,271m) compared with the budgeted income of R28,057m

(1997 : R24,879m). Expenditure amounted to R27,035m (1997 : R23,174m) compared with a budget of R27,135m (1997 : R24,079m).

PREDETERMINED OBJECTIVES

Since being listed as a public entity in terms of the Reporting by Public Entities Act in 1993, the CNS has taken deliberate steps to identify and define appropriately comprehensive objectives, representative of the wide range of work of the CNS, that can be subjected to performance assessment on a quantitative and financial basis.

The objects of the CNS are defined in the governing Statute (Section 34 of the Nuclear Energy Act, No. 131 of 1993) and require the CNS to establish a licensing process to regulate and exercise control over a range of activities involving nuclear energy and materials with a view to safeguarding the public and workforce.

For the year under review the objectives that were selected for reporting upon, together with the extent of their accomplishment, are described below.

LEGISLATION

To complete the preparation of a bill on nuclear regulation

During the year consultations with interested and affected parties and consequential redrafting of the developing text produced a document which was submitted to the Department of Minerals and Energy at the request of the Minister. It had not been finalised by the end of the reporting period.

Although preparation of documentation of this nature does not readily lend itself to quantitative financial analysis it is expected that the proposed amendments should clear the way for greater openness and improvements in the overall regulatory process.

TECHNICAL

To ensure that the safety status of nuclear installations is maintained at a level to prevent the occurrence of incidents and accidents

The majority of the CNS effort is applied to uphold acceptable standards of safety associated with the regulated installations and other activities involving radioactive materials.

Since safety, like risk, is intangible and cannot be measured directly, surrogate parameters lending themselves to monitoring and measurement need to be identified. Their identification demands in turn that regulatory safety goals are established in order that a complete

approach to safety, from safety philosophy to measurable objectives, can be implemented.

During the year safety goals were updated and these enabled work to commence on identifying specific measurables such as personnel exposure to radiation, equipment reliability, human performance and number of occurrences etc. With regard to the latter, two occurrences, both rated as level 2 on the INES scale, were reported from Koeberg. These occurrences nevertheless emphasized the continuing necessity for vigilance over the complete safety scene, thereby vindicating the commitment of the CNS to the totality of effort being expended in the Koeberg Safety Review (KSR).

Regarding the nuclear licence for the AEC, the stage was reached where a significant rationalisation of the licence took place following a major revision of radiation protection provisions at both organisational and procedural levels. This will facilitate demonstration of compliance and lead to improvements in cost effectiveness and transparency.

To ensure that all activities involving radioactive materials falling under the Act are licensed and controlled in accordance with acceptable standards

The two major licensees of the CNS, namely Eskom (Koeberg Nuclear Power Station) and the AEC (Pelindaba and Vaalputs sites) accounted for approximately three quarters of the technical effort expended by the CNS during the year.

Work on the Koeberg Safety Report (KSR), aimed at a complete safety re-assessment of Koeberg Nuclear Power Station against the highest current international standards and due for completion in FY 1999/2000, proceeded satisfactorily with the completion of the Safety Analysis Report which enabled the comparative exercise with an international reference to commence and highlighted topical issues such as the impact of demographic development.

The AEC continued with its program of re-assessing the safety of its facilities in order both to provide ongoing assurance of nuclear safety and the provision of updated documents for reference in the AEC licence.

As a result of the CNS' monitoring and inspection activities conducted at both Koeberg and the AEC sites, assurance was obtained that an acceptable level of safety was maintained at these facilities during the year.

Licensing activities in the mining and minerals processing industries concentrated on facilities that were already licensed, where assessment programs required completion in order that control programs could be determined.

With regard to workers, hazard assessments were approximately 90% complete for surface occupations and control measures continued to be implemented. The percentage of underground workers covered by hazard assessments increased from about 28% to 80% over the year and control measures were implemented at most of those facilities having the greatest potential for exceeding dose limits.

Hazard assessments for members of the public, a complex issue scheduled for completion at the end of FY 1998, received impetus from a guideline document from the CNS and from a program of inspections of licensed facilities and special technical meetings with licensees to resolve constraints.

HUMAN RESOURCES

To finalise the proposals for an affirmative action policy and to implement same.

The participative process involving CNS staff, management and the Council culminated in the determination of an internal policy which, inter alia, established numerical targets for categories of staff up to 2001.

To ensure that the staff complement remains at an optimum size

Consistent with the CNS policy of being cost effective in meeting its objectives and fulfilling its functions, and recognising the demands from its statement on quality regarding its needing to adopt a questioning attitude over the way in which it undertakes its duties, it proved possible to allow the eventual total staff complement to decrease by one following six retirements/resignations. Overall, however, staff shortages were still experienced in areas of high specialization such as radiation protection and engineering assessment.

To develop the career potential of staff through enhancing their knowledge, skills and abilities

Throughout the year, management selected staff on an individual basis to participate in specific activities in order to enhance their skills and improve their knowledge. These included training in conducting regulatory audits, in computer proficiency, in making presentations, and in improving job competency by attending specialist courses and conferences.

FINANCIAL

To restore the ratio of licence fees to state funding to 70/30 over the next three years

The motivation to the Department of Minerals and Energy in this respect was only partially successful in so far as the historical gradual reduction in the State offtake was halted and slightly reversed to maintain the ratio at 80:20 over the next three years.

To establish an improved costing systems providing for apportioning of expenditure on a licensing project basis

The development of this system was completed and preliminary trials demonstrated its satisfactory functionality. The system will be fully implemented from the commencement of FY 1998/99.

To continue the attempts to develop performance information on the efficient functioning of the organisation

Opportunity was taken to utilise the co-operative arrangements between the CNS and a number of similar organisations overseas in order to determine the extent to which performance information was available for nuclear regulatory bodies. It was apparent that despite the awareness of the potential value of such information, there was a virtual absence of practical results.

Year 2000 compliance – to initiate an investigation aimed at providing assurance that the computing capacity of the CNS can cope with the year 2000

A project was established by the Information Services group to investigate the potential disruptive impact on both the financial and technical work of the CNS. New software was purchased, and installation commenced, to provide for the maintenance of financial systems. A systematic approach to checking software utilised for technical purposes, together with a planned replacement programme for hardware, were established with a view to achieve 2000 compliance.

PUBLIC RELATIONS

To continue with the preparation and distribution of publicity information on the CNS and its work

The introductory range of new publicity material was published during the year and dissemination of an educational poster commenced with 1000 copies being mailed to interested parties.

To establish public and special interest stakeholder forums to increase awareness of nuclear safety

Recognising that the statutory exclusion of licensees from the Council gave rise to the need for an alternative means of communication, and that there existed a wider need to interface with stakeholder groups, the Council established an Advisory Committee on Stakeholder Interests.

Meetings were also held with members of the Parliamentary Portfolio Committees of both Minerals and Energy and Environmental Affairs and Tourism in order to acquaint them with the safety provisions at Koeberg Nuclear Power Station, and to brief them on topical nuclear safety issues.

ASSISTANCE TO EXTERNAL BODIES

To support, within the capabilities of the CNS, and with due recognition of political imperatives, the work of national and international bodies involved with the promotion of aspects related to nuclear safety.

The CNS was actively involved with the International Atomic Energy Agency and the Schonland Research Centre at the University of the Witwatersrand in developing a Regional Centre there for post graduate and other training on aspects of nuclear and radiation safety. Courses were held during the year on various aspects of radiological protection and were attended by participants from throughout the African continent.

The CNS also participated in the formulation of an academic curriculum for an industrial collaborative post graduate training program in Applied Radiation Science and Technology, and later presented some of the associated lectures, at the University of the North West.

Technical assistance was given to the continuing deliberations of the Integrated Pollution Control / Waste Management (IPC/WM) process in order to contribute to the further development of radioactive waste management.

Technical experts from the CNS contributed to the development of nuclear, radiation and radioactive waste safety associated with the continuing programs launched by the International Atomic Energy Agency, and the African Regional Co-operative Agreement (AFRA).

COUNCIL MEMBERS

The names of Council members holding office for the financial year are as follows :

- Prof J B Martin, (Chairperson), Deputy Vice Chancellor, Research, University of Cape Town.
- Prof K Bharuth-Ram, (Vice-Chairperson), Head : Physics Department, University of Durban-Westville.
- Dr D Reitmann, former Director, National Accelerator Centre : Foundation for Research Development.
- Dr T Auf der Heyde, Senior Lecturer, Department of Chemistry, University of Cape Town.
- Prof J F Klopper, Head : Department of Nuclear Medicine, Tygerberg Hospital.
- Dr M P Mandela, Assistant General Manager : Human Resources, Spoornet.
- Prof S H Taole, Physics Department, University of the North West.
- Mr B C Winkler, Executive Officer : CNS and ex officio member of the Council.

AUDIT COMMITTEE

The following members served on the Audit Committee :

- Dr D Reitmann (Chairperson), Member of the Council and former Director, National Accelerator Centre : Foundation for Research Development.
- Dr T Auf der Heyde, Member of the Council and Senior Lecturer, Department of Chemistry, University of Cape Town.
- Mr O P Sadler, CA (External Member), KPMG Pretoria.

The Audit Committee met twice during the financial year. The main purpose of these meetings was to review the overall external Audit plan, the financial statements and the External Auditors' Report.

REPORT OF THE AUDITOR-GENERAL

Report of the Auditor-General to parliament on the financial statements of the Council for Nuclear Safety for the year ended 31 March 1998

AUDIT ASSIGNMENT

The financial statements as set out on pages 4 to 21 for the year ended on 31 March 1998 have been audited in terms of Section 188 of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996), read with sections 3 and 5 of the Auditor-General Act, 1995 (Act No. 12 of 1995), and Section 49(4) of the Nuclear Energy Act, 1993 (Act No. 131 of 1993). These financial statements, the maintenance of effective control measures and compliance with relevant laws and regulations are the responsibility of the Council's Executive Officer. My responsibility is to express an opinion on these financial statements and compliance with relevant laws and regulations, applicable to financial matters, based on the audit.

REGULARITY AUDIT

NATURE AND SCOPE

Financial Audit

The audit was conducted in accordance with generally accepted government auditing standards. These standards require the audit to be planned and performed to obtain reasonable assurance that the financial statements are free from material misstatement. The audit was also planned and performed to obtain reasonable assurance that, in all material respects, the relevant requirements of the Reporting by Public Entities Act, 1992 (Act No. 93 of 1992), as amended, have been complied with. The audit includes:

- examining, on a test basis, evidence supporting the amounts disclosed in the financial statements;
- assessing the accounting principles used and significant estimates made by management; and
- evaluating the overall presentation of the financial statements.

I believe that my audit provides a reasonable basis for my opinion.

Compliance Audit

Furthermore, an audit includes an examination, on a test basis, of evidence supporting compliance in all material respects with the relevant laws and regulations applicable to financial matters. I believe that the audit provides a reasonable basis for my opinion.

Qualification

(a) Estimated income and expenditure for the financial year: In accordance with section 48(6) of the Nuclear Safety Act, 1993 (Act No. 131 of 1993), the Board must, in each financial year, and at a time determined by the Minister, submit a statement of the Council's estimated income and expenditure during the following financial year, to the Minister for his approval, granted with the concurrence of the Minister of the Department of State Expenditure. The Council's statement of estimated income and expenditure for the 1997-98 financial year was submitted to the Minister of Minerals and Energy before the determined time but was, however, only approved by the Minister on 5 May 1997, and submitted by the Department of Minerals and Energy to the Minister of the Department of State Expenditure for their concurrence on 3 June 1997.

The latter pointed out that, according to a legal opinion of the State Law Advisors, retrospective approval could not be granted and that the budget for the said financial year was therefore unauthorised.

The expenditure for the 1997-98 financial year is thus regarded as unauthorised in terms of section 33(1)(c) of the Exchequer Act, 1975 (Act No. 66 of 1975), and is reported as such.

(b) Investment of money: Money not required for immediate use in terms of section 48(4)(a) of the Nuclear Safety Act, 1993 (Act No. 131 of 1993), may be invested with the Public Investment Commissioners or, with the approval of the Council, with such other institutions as the Minister of Minerals and Energy may determine with the concurrence of the Minister of State Expenditure.

As at 31 March 1998, R6 million was on deposit at a commercial bank on a 60-day special deposit account, which is considered to be a short-term investment. Written consent from the relevant Minister that this institution was regarded as suitable, could not be submitted.

AUDIT OPINION

Financial Audit

In my opinion, the financial statements fairly present, in all material respects, the financial position of the Council as at 31 March 1998, and the results of its operations and cash flows for the year then ended in accordance with generally accepted accounting practice and the reporting requirements as set out in the Reporting by Public Entities Act, 1992 (Act No. 93 of 1992), as amended, and the regulations thereto. Furthermore, in my opinion, the information in terms of sections 6 and 7 of the Reporting by Public Entities Act, 1992 (Act No. 93 of 1992), is fair in all material respects and where applicable, on a basis consistent with that of the preceding year.

Compliance audit: Qualified opinion

In my opinion, except for the matters discussed in paragraph 2.1 (2)(a) and 2.1 (2)(b)

- the transactions of the Council that were examined during the course of my audit were made in accordance with the applicable laws and regulations; and
- the transactions that came to my attention during auditing were in all material respects in accordance with the mandatory functions of the Council as determined by law or otherwise.

EMPHASIS OF MATTERS

Without affecting the audit opinion expressed above, attention is drawn to the following matters:

Year 2000 compliance of computer systems: Attention is drawn to the fact that addressing the Year 2000 compliance issue is the responsibility of the Executive Manager of the Council for Nuclear Safety.

Notwithstanding the actions that are being taken to address the effect of the Year 2000, a full integrated systems test has not been performed to confirm the adequacy of these actions. I did not perform any procedures to test whether the Council for Nuclear Safety's system or any other related systems are Year 2000 compliant. Accordingly, I do not express any opinion or provide any other assurances regarding the Year 2000 compliance of computer systems in operation at the Council for Nuclear Safety.

Reporting by Public Entities Act, 1992 (Act No. 93 of 1992): Director's Report: Although, in general, the Director's Report contains the information as required by section 7 of the Reporting by Public Entities Act, 1992 (Act No. 93 of 1992), as amended, only the more quantifiable objectives and key performance areas have been included in the report. During the year under review the Council took further steps to establish the necessary information systems in order to report more comprehensively.

Pretoria, 20/10/98

J C L Hughes
For Auditor-General

AUDITOR-GENERAL

STATEMENT 1
BALANCE SHEET AS AT 31 MARCH 1998

	Notes	1997-98 R	1996-97 R
Capital employed			
Income funds		13 202 278	11 941 372
Long-term liability	2	0	41 004
		13 202 278	11 982 376
Employment of capital			
Fixed assets	3	1 923 134	1 350 610
Net current assets		11 279 144	10 631 766
Current assets		13 460 122	12 733 388
Debtors	4	4 767 764	3 754 788
Payments made in advance		76 058	127 692
Deposits and immediately claimable amounts		2 000	2 000
Bank balance and cash		8 614 300	8 848 908
Less:			
Current liabilities		2 180 978	2 101 622
Creditors and provisions	5	2 180 978	2 077 020
Short-term loan		0	24 602
		13 202 278	11 982 376

Centurion, 28/10/98

B C Winkler,
Executive Officer

J B Martin,
Chairperson

STATEMENT 2
INCOME STATEMENT FOR THE YEAR ENDED 31 MARCH 1998

	Notes	1997-98 R	1996-97 R
Income funds - beginning of the year		11 941 372	8 499 967
Operating surplus	6	1 260 906	3 441 405
Income funds - end of the year		13 202 278	11 941 372

STATEMENT 3
CASH FLOW STATEMENT FOR THE YEAR ENDED 31 MARCH 1998

	Notes	1997-98 R	1996-97 R
Cash flows from operating activities		1 228 105	4 085 838
Cash generated from operations	A	(113 046)	3 003 704
Interest received		1 395 514	1 093 687
Interest paid		(54 363)	(11 553)
Cash flows from investing activities		(1 421 709)	(781 583)
Acquisition of fixed assets	B	(1 422 852)	(783 034)
Proceeds on disposals of obsolete assets	C	1 143	1 451
Cash flows from financing activities		(41 004)	(24 602)
Decrease in long-term liabilities	D	(41 004)	(24 602)
Net (decrease) / increase in cash and cash equivalents		(234 608)	3 279 653
Cash and cash equivalents at beginning of the year	E	8 850 908	5 571 255
Cash and cash equivalents at end of the year	F	8 616 300	8 850 908

SCHEDULE A
NOTES TO THE CASH FLOW STATEMENT

		1997-98 R	1996-97 R
A	*Cash generated by operations*	(113 046)	3 003 704
	Operating surplus for the year	1 260 906	3 441 405
	Adjustment for:		
	Depreciation	821 241	656 211
	Interest received	(1 395 514)	(1 093 687)
	Interest paid	54 363	11 553
	Net loss on disposals of obsolete assets	27 944	(305)
	Working capital changes	(881 986)	(11 473)
	Increase in debtors	(1 012 976)	(278 041)
	Decrease in payments made in advance	51 634	56 363
	Increase in creditors and provisions	103 958	210 206
	Decrease in short-term loan	(24 602)	(1)
B	*Acquisition of fixed assets*	(1 422 852)	(783 034)
	Office furniture	(70 052)	(50 010)
	Office equipment	(40 558)	(57 902)
	Scientific and technical equipment	(33 459)	(59 014)
	Computer equipment	(851 283)	(623 108)
	Property	(427 500)	0
C	*Proceeds on disposals of obsolete assets*	1 143	1 451
	Loss on disposals	(27 944)	305
	Book value of assets disposed of	29 087	1 146
	Cost	154 637	34 075
	Accumulated depreciation	(125 550)	(32 929)
D	*Decrease in long-term liability*	(41 004)	(24 602)
	Loan repaid	(41 004)	(24 602)
E	*Cash and cash equivalents at beginning of the year*	8 850 908	5 571 255
	Bank balance and cash	8 848 908	5 569 255
	Deposits and immediately claimable amounts	2 000	2 000
F	*Cash and cash equivalents at the end of the year*	8 616 300	8 850 908
	Bank balance and cash	8 614 300	8 848 908
	Deposits and immediately claimable amounts	2 000	2 000

1. ACCOUNTING POLICY

The financial statements are compiled on the historical cost basis in accordance with the undermentioned policies, which were applied consistently in every respect.

1.1 Income

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 are written off over the expected useful life according to the fixed instalment method.

Expected useful lives are : 10 years for furniture,
: 5 years for office equipment,
: 5 years for scientific and technical equipment,
: 3 years for computer equipment.

The property is considered an investment property and accordingly is not depreciated. It will be re-evaluated from time to time at its current market value.

1.4 Expenditure for research and development

Expenditure for research and development is written off in the Income Statement in the year in which it was incurred.

1.5 Leased assets

Assets acquired under finance lease agreements are capitalised. Operating lease rentals are charged against income as incurred.

2. LONG-TERM LIABILITY

	1997-98	1996-97
	R	R
Capitalised financial lease fully paid during the year	0	41 004

SCHEDULE B
(continued)

3. FIXED ASSETS

	Furniture	Office equipment	Scientific and technical equipment	Computer equipment	Property	Total
	R	R	R	R	R	R
Carrying amount at 31 March 1997	260 112	189 249	60 742	840 507	0	1 350 610
At cost	411 711	350 715	2 043 101	3 450 848	0	6 256 375
Accumulated depreciation	(151 599)	(161 466)	(1 982 359)	(2 610 341)	0	(4 905 765)
Additions	70 052	40 558	33 459	851 283	427 500*	1 422 852
Disposals	(1 539)	(483)	0	(27 065)	0	(29 087)
Depreciation for the year	(45 581)	(80 078)	(10 733)	(684 849)	0	(821 241)
Carrying amount at 31 March 1998	283 044	149 246	83 468	979 876	427 500	1 923 134
At cost	479 501	388 105	2 070 080	4 159 404	427 500	7 524 590
Accumulated depreciation	(196 457)	(238 859)	(1 986 612)	(3 179 528)	0	(5 601 456)

* *The property consists of an office block situated on the erf 3187 Melkbosch Strand in the Blaauberg Municipality, Cape Division, Western Cape Province. It was acquired on deed of sale dated 3 October 1996 at the cost of R 427 500,00 and registered in the name of the Council on 22 April 1998.*

4. DEBTORS

	1997-98	1996-97
	R	R
Trade debtors	4 495 124	3 496 853
Less: Provision for doubtful debts	(100 000)	(100 000)
Net trade debtors	4 395 124	3 396 853
Other debtors	372 640	357 935
	4 767 764	3 754 788

5. CREDITORS AND PROVISIONS

Trade creditors	915 148	701 883
Other creditors	50 830	160 137
Provision for accumulated leave	1 115 500	1 115 500
Provision for audit fees	100 000	100 000
	2 180 978	2 077 020

6. OPERATING SURPLUS	Notes	1997-98 R	1996-97 R
Income		28 296 026	26 615 421
State contribution		5 400 000	5 271 000
Licensing fees		21 318 119	19 943 783
Special services*		180 961	277 856
Interest		1 395 514	1 093 687
Sundry		1 432	29 095
Less: Expenditure		27 035 120	23 174 016
Audit fees		95 398	109 616
Provision for audit fees		100 000	100 000
Over/(under) provision previous year		(4 602)	9 616
Bad debts written off as irrecoverable		0	6 504
Computer software		389 683	254 385
Consultancy		644 587	274 776
Consumable stores		231 027	152 412
Depreciation on assets	3	821 241	656 211
Net loss on disposal of obsolete assets		27 944	(305)
Finance cost		54 363	11 553
Insurance		117 613	116 853
Library items		121 118	93 201
Operating leases		249 053	252 072
Personnel expenses		19 261 291	17 242 598
Post- retirement benefit		174 302	158 668
Postal and telephone services		366 651	330 993
Provision for accumulated leave		0	8 000
Rent, accommodation		1 074 737	947 683
Research contracts		122 358	93 314
Service contracts and maintenance		780 400	533 233
Stationery and printing		237 536	177 493
Subsistence and transport expenses		1 928 337	1 440 853
Sundry expenditure		337 481	313 903
Operating surplus		1 260 906	3 441 405

* *Radiological protection services rendered to organisations that are not licensees of the CNS.*

SCHEDULE B
(continued)

7. CONTINGENT LIABILITY

The intention of the Council was firstly to establish a fund for the pre-funding of medical subscription contributions for pensioners who were in its employ prior to 1 July 1990 and for whom the Council has a liability.

For this propose the Council, over a two-year period, built up funds to the amount of R2 800 000. The proposal for the fund did not receive the support of the Minister of Finance.

8. CNS RETIREMENT FUND

All employees are members of the CNS Retirement Fund, a defined benefit fund governed by the Pension Fund's Act of 1956. The fund was established on 1 December 1994 following withdrawal by the CNS from the Associated Institutions' Pension Fund. The employees' contribution rate is 7.5% of pensionable salary.

A full actuarial valuation of the Fund was done in April 1996 and it was found that the funding level was 96.2%. The Fund has been certified as sound, and an actuarial valuation will again be done within the prescribed period of three years from the date of the valuation.



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