SPECIAL REPORT

Policy options for the nuclear industry in South Africa

By A. A. Eberhard

Under successive nationalist governments, the nuclear industry in South Africa has received favoured access to state resources. Along with the synthetic liquid fuels sector, vast investments were made in developing local capacity to exploit indigenous fuels and to reduce reliance on fuel imports. However, South Africa never achieved full self-reliance in liquid or nuclear fuels, which, in part, continued to be imported at substantially lower prices than local production costs.

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The decision whether to build further nuclear power stations, and/or to maintain an indigenous nuclear fuels industry, will, in the future, be based on rational analysis derived through integrated energy planning within a policy framework which seeks to advance social equity, economic competitiveness and environmental sustainability.

Current analyses indicate that nuclear power is more expensive than other electricity generating options such as clean coal or natural gas power stations or regional hydro-electric power. Given Eskom's (the state controlled South African utility) existing overcapacity, it is unlikely that new electricity generating plants will be commissioned before the first decade of the next century and even if the next plant were nuclear, it is far from certain that Eskom will purchase fuel from the Atomic Energy Corporation (AEC).

The nuclear fuel operations of the AEC have been shown to be uneconomic and given the overwhelming demands on the fiscus, continued government subsidies for the AEC cannot be justified. Furthermore, Eskom will have to revise its current contract with the AEC which effectively provides an additional subsidy. A decision to unravel the substantial technological capacity that exists within the AEC cannot be taken lightly - an indigenous nuclear fuels industry cannot easily be recreated and many highly skilled personnel will lose their employment. However, a sober assessment of international markets, indicates that the AEC is unlikely to secure income to cover operating costs. Viable technological processes and products should be privatised and remaining technological competencies should be transferred to the CSIR and other research institutions. Applications for state support for technology development would be treated on merit within the general science and technology budget.

The activities of NUFCOR will be relatively unaffected by these policy interventions and they will be encouraged to concentrate on developing their export market for uranium oxides.

Shifting policy paradigms

The context for energy policy and planning in South Africa is shifting radically. Gone are the exclusive concerns of fuel security and self sufficiency of an apartheid government beleaguered with international sanctions. As the country moves towards widened democracy and is accepted back into the international community, energy policy will align itself with new social and economic policies aimed at reconstruction and development. Energy policy specifically will seek to:

- Improve social equity by specifically addressing the energy requirements of the poor;
- Enhance the efficiency and competitiveness of the South African economy by providing low-cost and high quality energy inputs to industrial, mining and other sectors; and
- Work towards environmental sustainability by addressing both short-term environmental problems, and planning for a long-term transition towards renewable sources of energy with minimum negative environmental impact.

In the South African context, these three principles encapsulate the desirable features of post-apartheid energy policy. The primary goal of democratic government will be to address the high levels of inequality which characterise both the energy sector, and the economy as a whole. At the same time, inefficiencies in the energy sector will have to be eliminated, particularly those which were shielded by the state's energy security policies, so as to maintain and enhance the comparative advantage inherent in the country's relatively cheap supplies of energy. On the other hand, the low cost of South African coal and electricity is attributable, at least in part, to the lenience of environmental controls over the various stages of electricity generation cycle, and energy policy will therefore have to include adequate management of environmental impacts arising from energy production and use. In the longer-term, policy will have to address the essentially finite resource base on which the energy sector, and indeed, the whole economy, is founded (Eberhard and von Horen 1993).

The above shift in policy recognizes the linkages between the energy system and the economy and also the need to balance and integrate policy interventions across the different energy sub-sectors. The focus has begun to shift away from traditional supply-side to integrated energy planning (Eberhard 1993).

Energy planning in South Africa has been supply orientated and has been restricted to individual energy sub-sectors. For example, Eskom undertook its own planning without reference to any of the other energy sub-sectors and, ultimately, with inadequate reference to trends in the economy. And the largest proportion of the Department of Energy's budget has been for the Atomic Energy Corporation which was never evaluated on equal terms with other energy needs. The result of this exclusive focus on energy supply and on individual energy sub-sectors, was massive over-investment - the level of spare electricity generation capacity must be a world record. In the case of the Sasol, Mossgas and uranium enrichment plants, supply-side planning, it will be argued, led to a gross mis-allocation of resources and the production of fuels at costs much higher than international prices. Integrated energy planning is essential if rational and efficient policy interventions and investments are to be made.

Where does nuclear energy fit within this changing policy environment with its emphasis on social equity, economic competitiveness and environmental sustainability achieved through a process of integrated energy planning? If the nuclear industry is to survive it will have to demonstrate that it is economically competitive and is not an unnecessary drain on the country's fiscus when there are more pressing social priorities. The industry will also have to demonstrate that it can contribute to environmental sustainability.

To assess the future of nuclear power in South Africa, a basic understanding of the existing nuclear industry and its recent history is necessary.

The nuclear fuel industry

South Africa has one nuclear power station, at Koeberg, 30 km from Cape Town. It has a capacity of 1822 MW out of a total electricity generating capacity of 39 000 MW and in 1992 sent out 6 per cent of South Africa's electricity.

South Africa has large uranium reserves, but Koeberg has sourced most of its enriched fuel from abroad. Successive nationalist governments have invested substantial amounts in building up a local nuclear fuel chain which now supplies part of Koeberg's fuel.

South Africa's nuclear involvement was formalised in 1948 when the Atomic Energy Board (AEB) was established by an Act of Parliament to exercise control over and trade in uranium. The Uranium Enrichment Corporation of South Africa (UCOR) was established in 1970 and in 1985 it was amalgamated with the Nuclear Development Corporation (NUCOR, previously the AEB) to form the Atomic Energy Corporation (AEC), which reports through a Chief Executive and Chairman to the Department of Mineral and Energy Affairs.

The AEC operates a nuclear research centre at Pelindaba, a uranium conversion and enrichment plant at Valindaba (both near Pretoria) and a radioactive waste disposal site at Vaalputs in the northern Cape. Eskom owns and operates Africa's only nuclear power station.

The nuclear fuel chain

The fuel for nuclear powered electricity generation plants derives from uranium oxide (U_3O_8) which is then converted to uranium hexafluoride (UF_6), enriched to about 3.5 per cent of the uranium isotope U_{235} and assembled in fuel rods. After being used to generate electricity, the spent fuel, in principle, may be reprocessed to separate out plutonium. The radioactive waste fuel is stored temporarily pending a solution to the problem of final safe disposal.

In South Africa, uranium oxide is produced by the Nuclear Fuels Corporation (NUFCOR) which is part of the Chamber of Mines of South Africa. Uranium oxide derives from ammonium diurnate slurries which are a by-product of the gold mining industry. The slurries are collected by NUFCOR's specialised road tankers from extraction plants on the properties of member companies. NUFCOR blends the slurries and calcines it into exportable concentrates containing about 95 per cent uranium oxides. Its calcining plant is near Johannesburg and employs about 40 people. NUFCOR is responsible for all uranium exports. Its head office is in Johannesburg and has a staff of 8 which market uranium to mostly large nuclear power generating utilities in Europe, the Americas and the Far East. NUFCOR also supplies uranium oxide to the AEC which operates conversion, enrichment and fuel fabrication plants. South African uranium production reached a peak of 6000 t U in 1980 and along with global production has declined steadily since then. Between 1990 and 1991, South Africa's uranium production declined a further 30 per cent to below 1700 t. The value of current exports is around 250 million Rand (MZAR) per annum.

The international market is being supplemented by huge inventories built up during the 1970s and 1980s. These amount to 153 000 t U in the West compared to demand of 47 000 t U in 1991, while in the former communist countries inventory estimates are anywhere between 140 000 and 200 000 t U. The changed market structure has brought about substantial changes in price formation. Instead of being determined by production costs, the level and direction of prices are today set in a trading-dominated spot market environment (Auf der Heyde 1993).

The AEC's conversion (U_3O_8 to UF_6) plant, known as the U-Plant, at Valindaba has a capacity of 1200 t of uranium per annum, which exceeds Koeberg fuel requirements. It commenced production in 1986 and cost 55 MZAR. Production in 1991/2 was less than 700 t and is envisaged to remain at about 50 per cent of capacity for the next few years. It will fall substantially if local enrichment is discontinued. In 1992 short-term export contracts were obtained for 200 t uranium converted to UF_6.

South Africa secretly began developing a uranium enrichment process in the early 1960s. The first laboratory was hidden behind the facade of a motor-spares shop in Du Toit Street in Pretoria!). Prime Minister Vorster announced in 1970 that scientists had developed a unique and economical enrichment process based on the aerodynamic stationary-wall centrifuge, or vortex tube process. The development was certainly unique (the only enrichment process used on a large scale at the time was the gaseous diffusion process, with centrifuge systems beginning to be developed); but its commercial viability was unproven and unlikely, given the extensive size of the plant and its high energy input requirements.

A pilot-scale plant, called the Y-Plant, was built at Valindaba in the early 1970s at a cost of 210 MZAR and after a long commissioning period commenced production of highly enriched uranium in 1978/9. Apart from a halt in production from August 1979 to July 1981, it was operated until its closure in 1989. Its production capacity was 20 000 Separative Work Units (SWU). Construction of a semi-commercial enrichment plant, the Z-Plant, was begun in 1979 and was completed at the end of 1986 at a cost of 785 MZAR, but after commissioning problems did not begin production until 1988. The plants's production capacity is 275 000 SWU per annum. In 1992, about 190 000 SWU were produced and 27.2 t of 3.25 per cent enriched uranium were processed. Of this 13 t were supplied to Koeberg in complete fuel assemblies.

Planners in the 1970s envisaged a significant nuclear power construction programme. The semi-commercial enrichment plant was required to service four nuclear power reactors of about 900 MW. However, only two reactors have been constructed (at Koeberg) and the AEC has been supplying one of these. The AEC has now finally acknowledged that the Z-plant is non-viable and hopelessly energy inefficient. Average energy consumption for centrifuge enrichment is quoted at 50 kWh/SWU and those for diffusion technologies at 3000 kWh/SWU. The energy consumption of the Z-plant has been estimated as 9200 kWh/SWU. The plant has thus used close to 200 MW of electricity to produce fuel to power a 900 MW nuclear reactor which is operating at less than half its design capacity. Eskom supplies electricity for the enrichment plant at slightly more than marginal cost. The AEC undertakes separative work at international USA Department of Energy (DOE) prices and the AEC's uranium inventory is sold to Eskom at historic cost. These are all substantially above international market prices. The AEC has accepted that the Z-plant will have to be closed. It will cost about 20 MZAR per annum for a number of years to decontaminate the Z-plant.

A new pilot-scale enrichment plant is being constructed based on the molecular-laser isotope-separation (MLIS) process. Approximately 30 MZAR per annum is being spent on this project whose viability will be re-evaluated in March 1996 and will only be continued if a commercial partner is found. The AEC claim four breakthroughs in its MLIS research: an efficient nozzle that allows extremely rapid cooling over fairly long distances of the incoming UF_6 stream; the first industrial-scale carbon dioxide laser; the first industrial-scale Raman cell; and a single step enrichment process up to about 4 per cent U_{235} on a macro-scale. It is difficult to independently assess these claims or potential commercial viability of the process except that some caution must be expressed given the AEC's past track record with "breakthroughs" in enrichment technology. The USA, alone, has spent over a 1 000 MUSD on another laser technique, AVLIS, without significant success. The uranium enrichment operations of its Department of Energy are being privatised and future decisions on technology options will be market led.

The AEC has also developed a capacity to process enriched uranium into fuel rods for nuclear reactors. In 1981 it began manufacture of fuel rods for its experimental reactor, Safari I and by 1989 was producing a full re-load for one of Koeberg's reactors, 5 years after Koeberg began operation. Framatome of France, which supplies fuel rods for Koeberg's other reactor, has now started sub-contracting with the AEC for the fabrication and supply of fuel elements. The fuel fabrication plant (BEVA) at Pelindaba, which was built for 267 MZAR, has a production capacity of 100 t uranium per annum. Plant utilisation has seldom been higher than 25 per cent of production capacity. The AEC's zirconium-alloy tubing plant (which supplied tubing for the fuel rods) has been closed and virtually all metal alloy components are now imported.

South Africa does not have the technology to reprocess spent nuclear fuel. According to an agreement with the French-led consortium which built Koeberg, all reprocessing of Koeberg's irradiated fuel rods must be done in France. Spent fuel rods are left to cool in water tanks at Koeberg.

The AEC has operated the Vaalputs waste disposal site since 1986 and claims that it recovers costs by passing these on in full to clients, mainly Eskom. Koeberg's fuel pools will be full between 1996 and 1998 and interim fuel storage in above ground flasks is envisaged. The Vaalputs facility is the one operation of the AEC which is guaranteed future inputs. Research work is continuing on better disposal techniques.

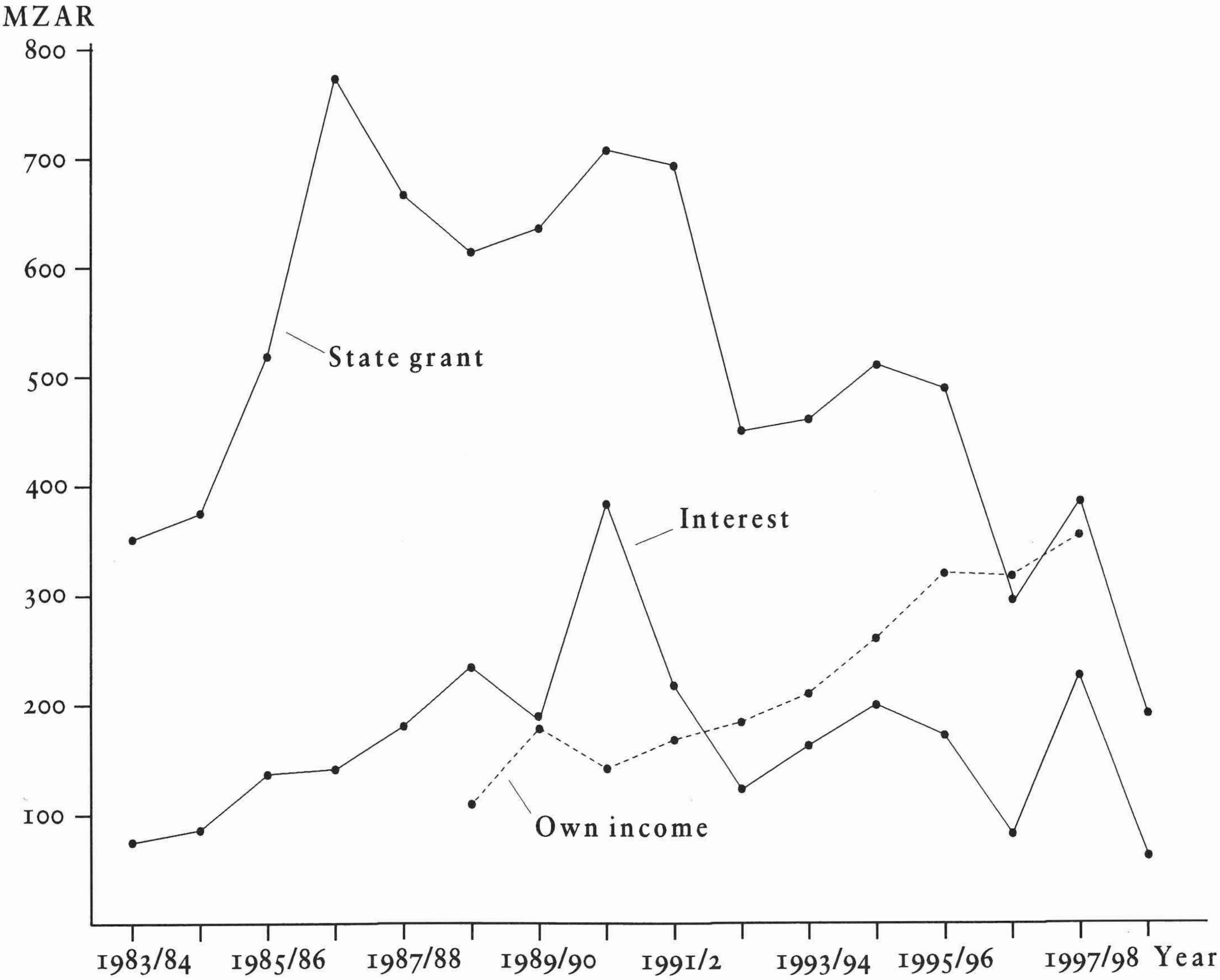
Weapons programme

The development of an indigenous nuclear fuel cycle was only partially motivated by a concern to support a national nuclear electricity generation programme. The other motive was to develop nuclear weapons. The existence of an apparently peaceful nuclear electricity generating programme was the cover for developing scientific and technological capacity in uranium enrichment.

The Y-plant was used not just to produce enriched uranium for the research reactor, Safari I, or to merely test an indigenous enrichment technology; crucially it was also used to produce highly enriched uranium for weapons production. This decision was taken in 1974. President De Klerk has stated that six nuclear fission devices had been manufactured by 1989 when the decision was taken to dismantle them and that South Africa would accede to the Nuclear Non-proliferation Treaty which it did on 10 July 1991.

The Y-plant was de-commissioned in 1990 and a multi-year decontamination programme is underway.

Figure 1
DMEA grants to AEC, loan, interest repayments and own income



Source: AEC

The AEC's non-nuclear fuel chain activities

The AEC's research reactor, Safari I, produces a number of useful products such as medical isotopes. Its annual operating costs are approximately 6 MZAR. The aim is to cover costs from commercial sales by 1997.

The AEC has embarked on an aggressive programme to extend core competencies to non-nuclear fuel chain technologies and under the PTP (Pelindaba Technology Products) umbrella has established the following business units and companies: Nuclear Techniques Industrial Services (NTIS), Isotope Production, New-product Industrialisation, Aerosols and Air Quality, Fluorochemicals, Flosep, Noise Analysis, Lumitec, Specialised Plating, Earth and Environmental Technology, Biogram, Turbosystems and Technology, and High Technology Products. About 40 MZAR is spent on technology development per annum. Currently fluorochemicals, turbosystems, isotopes and Flosep account for over 75 per cent of turnover. Turnover is projected to rise from 60 MZAR in 1993 to 275 MZAR by 1997 and 450 MZAR by 2000. Even excluding the 40 MZAR spent on technology development, these "business" units are still making a loss, which in 1991 amounted to 17 MZAR. Exports account for about 10 per cent of earnings. The AEC predicts that PTP will break even in 1993 and will make a profit of 35 MZAR by 1997 and 70 MZAR by 2000 AD.

AEC 2000 Plus – a commercial vision

In the period up to 1990, investment and expenditure decisions regarding the AEC were made on strategic and security grounds as defined by the apartheid nationalist government. The AEC operated its nuclear fuel cycle at any cost, indigenous technology was considered necessary in the face of international sanctions, export markets were denied, there were limited economies of scale and a secrecy culture was dominant. Following the closure of the weapons programme in 1990, hard choices faced the AEC. Either it was to be closed down, investments written-off and skills and know-how dissipated or it was to be commercialised, costs reduced, income increased, activities rationalised, skills and technology applied to commercial products and R&D replaced with income generating technology development. The latter option was selected. The AEC has now developed a vision of being a technology leader which contributes significantly to wealth generation. It has developed a business plan with a new commercial emphasis which recognises that nuclear fuel production has to be internationally competitive. It aims to supply agreed-to nuclear fuel products and services to Eskom and selected foreign customers on a commercial basis. In particular, the Nuclear Fuel Production Unit aims to produce added-value products and services related to uranium hexafluoride, enriched uranium, nuclear fuel components and spent-fuel storage services, thereby creating opportunities for the uranium mining industry, spin-offs for local manufacturing industry, a contribution to exports and foreign exchange earnings and savings and the creation of jobs.

The commercialisation plan also crucially depends on income generation from non-nuclear fuel technologies, mentioned above. The AEC aims by 2000 AD to be independent of state funding.

As part of its commercialisation and loss-cutting drive, the AEC has closed its Delta 2 zirconium project, zircaloy tube plant, pilot enrichment Y-Plant, centrifuge enrichment research programme, fusion research, reactor development and its Gouriqua site. Its Z-Plant will close shortly.

The AEC still has to demonstrate that its scientific and technological competencies and investment in technology development are wealth generating. All main divisions of the AEC (with the possible exception of the Vaalputs operation) require significant grants from the state to survive. The budget for the AEC's corporate headquarters alone amounted to over 80 MZAR in 1992.

Cost-benefit analysis of the nuclear fuels industry

The Atomic Energy Corporation receives substantial annual grants from the Department of Mineral and Energy Affairs, as indicated in Figure 1. A significant proportion of the grant is for redemption and interest repayments on State guaranteed loans which the AEC inherited from UCOR in 1982. Projections supplied by the AEC indicate that it anticipates remaining dependent on state grants over the next 5 years, despite optimistic forecasts of increased income from non-nuclear technology products.

Currently about half of the AEC's total operating expenses are consumed by nuclear fuel production. Figure 2 indicates income and expenditure for this division. Of the approximately 170 MZAR required from the state for nuclear fuels production in 1994, 51 per cent is needed for enrichment, 22 per cent for fabrication, 11 per cent for conversion, 5 per cent for nuclear waste technology and 11 per cent for other purposes.

It is clear that the nuclear production facilities at the AEC are not commercially viable, even with the favourable electricity rates provided by Eskom and the inflated prices it pays for its nuclear fuel. Disaggregated figures for the different nuclear production facilities are shown in Table 1.

The AEC production costs are between 2 and 4 times current spot prices, without even taking into account capital expenditure and depreciation. It is clear that the AEC has charged well above market rates to local customers - notably Eskom, nevertheless its production costs remain more than double these inflated prices.

The AEC's non-nuclear (Pelindaba Technology Products) is also currently making a loss. If one assumes that the current 40 MZAR spent on non-nuclear technology development will continue in future years, then sales income will exceed operating expenses only in 1994/5.

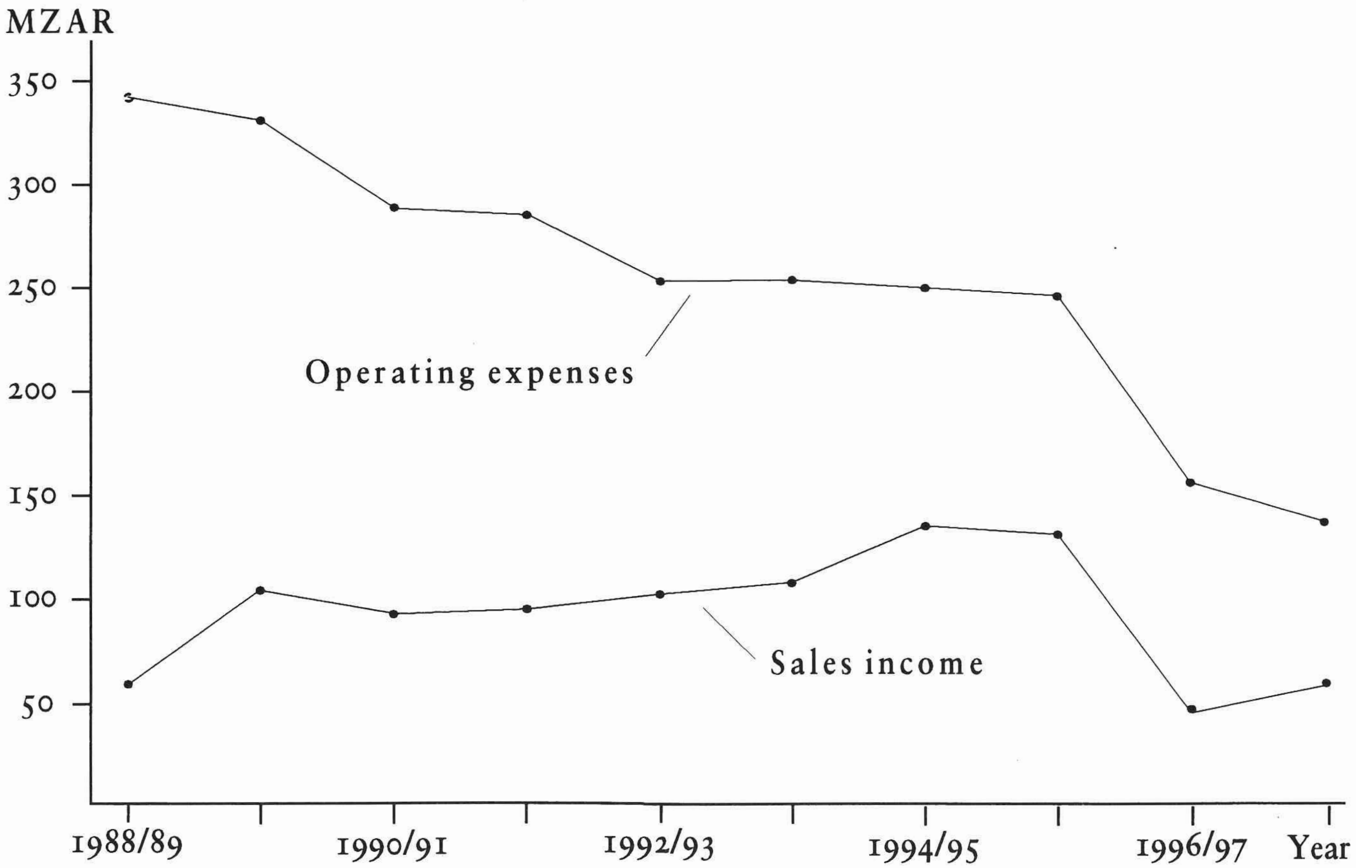
This cursory investigation of the AEC's recent income and expenditure accounts reveals massive deficits, debt (in excess of 800 MZAR in 1992) and state grants with disproportionately little value-added output. If the main motivation for the AEC's existence has been to support nuclear electricity generation, then its output has been singularly disappointing - fuel for 4 of the 9 years of Koeberg's operation to date, and then only for one of its two reactors, and this at a cost of many billions of rand of state expenditure. It would have been a great deal cheaper for both Eskom and the country if all of Koeberg's fuel was supplied from abroad.

Table 1
AEC average production costs and sales prices compared to spot prices in 1993 - ignoring capital expenditure

	Conversion ZAR/kgU	Enrichment ZAR/SWU	Fuel fabrication ZAR/kgU
AEC production cost	47	879	2 259
AEC sales price	24	619	1 2394
Spot price (June 93)	15	224	1 100

Source: Auf der Heyde 1993

Figure 2
Sales income and expenditure for the AEC's nuclear fuel production



Source: AEC

It has been argued that South Africa faced an international nuclear fuel embargo and that it was essential to develop an indigenous fuel cycle - but Eskom has always managed to obtain fuel from abroad (just as South Africa continued to obtain oil despite an UN oil embargo). In any case, Eskom has had significant excess generating capacity and the closure of Koeberg would not have prejudiced South Africa's energy security.

Of course, the AEC has produced more than simply 4 years of fuel for one of Koeberg's reactors (operating much below capacity). The development of scientific and technological skills is not easily valued. Some converted and enriched uranium has been exported. It produced material for at least 6 atomic bombs, although what practical, politically-sane, use these could have had is beyond comprehension. Some of the AEC's non-nuclear fuel technologies are now beginning to generate income - but, as a whole, they are still making a loss, even ignoring the large amounts that are being spent on technology and business development.

The AEC's best budget for the next 5 years, envisages continued large state grants -totalling over 1 000 MZAR and a further three-quarter billion rand in interest and loan redemption. The Z-plant will close during this period and Eskom will cease buying enriched uranium from the AEC.

The inescapable conclusion, therefore, must be that the costs of the AEC have hugely outweighed the benefits and future state support for the AEC has to be reconsidered.

Policy scenarios

It is clear from the above analysis that the onus is on the AEC to show why State support should not be withdrawn.

The AEC assumes that the next nuclear power plant will have to be commissioned by Eskom sometime in the first decade of the next century and that many more will be built in ensuing years. They argue that it is essential for South Africa to maintain a nuclear technological capability in order to support an indigenous nuclear fuel chain including conversion, enrichment, fuel fabrication and disposal. They argue, further, that their technological competencies are potentially wealth generating. Closure of the AEC, they argue, would result in the loss of these skills and will make it virtually impossible for South Africa to re-start a local nuclear fuels industry in the future.

Eskom will have to commission new generating capacity (or effect dramatic power savings through demand side management) sometime in the first decade of the next century. At this stage, Eskom's first preference is not nuclear power, as generating costs are still very much higher than alternatives. The most likely options are a further coal-fired plant (with adequate pollution control), hydro-electricity imports from the region, or a natural gas fired power station. The latter two options imply much lower greenhouse gas emissions. There is no certainty as to when Eskom would next commission a nuclear plant.

It would thus be a minimum of two decades, and probably more, before Eskom might want to purchase nuclear fuel for further reactors. Even in this scenario, it is also far from clear that Eskom would want to purchase fuel from the AEC. Indeed, Eskom has now made it clear that it will not continue to purchase fuel from the AEC's Z-Plant which will be forced to shut down by 1996 and possibly sooner. The AEC's hope for remaining in the enriched uranium business rests with the experimental MLIS enrichment process whose commercial viability remains unproven. The question arises as to whether this is a propitious time to be investing in new enrichment technology.

The AEC predicts that international markets for enriched uranium will pick up after 1995 when new nuclear power plants will be commissioned. An international review, indicates that relatively few new nuclear power stations are being built or ordered and, given the long design and construction lead-in times for new plants, it is thus unlikely that demand for enriched uranium will increase dramatically in the next two decades. It also remains the case that there are substantial stockpiles and spare production capacity for uranium enrichment following the dramatic fall in nuclear weapons production and the dismantling of existing weapons. The USA has a contract with Russia for the deconcentration of Highly Enriched Uranium. The entry of Russia and the other CIS states into international markets will increase supply and depress spot markets further. Most analysts agree that uranium conversion, enrichment and fuel fabrication for the next fifteen to twenty years will outstrip demand by as much as 70 or 80 per cent (Auf der Heyde 1993).

Twenty years is a long time to maintain a nuclear fuels production capacity in the hope that new nuclear power plants might be built and demand for fuel will increase.

The AEC may be correct in suggesting that closure of the AEC will severely prejudice the possibility of re-creating an indigenous nuclear fuel production industry. However, the track record of the past must be considered. The AEC has been unable to produce a competitive, commercially viable nuclear industry despite massive, almost unrestricted, investments. Considering also the uncertainties of future demand, a prudent decision would be to cut losses now. No further state subsidies should be provided for nuclear fuel production and supporting services and the conversion, enrichment and fabrication plants will have to be closed down if they cannot show a trading profit or if commercial partners are not found.

The commercial viability of the MLIS pilot plant will have to be carefully assessed and unless investment partners are found to upgrade the process to a commercial plant, the programme will have to be discontinued. A considered opinion is that no commercial partners will be found. A consequence of the closure of the Z-plant and termination of MLIS development, will be the closure of the conversion and BEVA fuel fabrication plants.

Safari I should remain in operation only if commercially viable. The aim will be to reduce the state grants to the AEC to below 20 MZAR per annum, much of this devoted to decontamination of radioactive plant at Pelindaba and Valindaba.

A fundamental review of the remaining functions of the AEC should be undertaken and the possibility explored of transferring all regulatory functions as well as the management of the Vaalputs waste storage facility to a beefed-up Council for Nuclear Safety.

It will be important to track whether the AEC's PTP business units break even and whether technology development costs can be covered by income generation. Non-nuclear fuel business units should be privatised and research into promising technologies, including skilled human resources, should be transferred to the CSIR.

NUFCOR operates without any state subsidies and should be encouraged to continue earning valuable foreign exchange through exports.

Conclusion

The decision as to whether to build further nuclear power stations, and/or to maintain an indigenous nuclear fuels industry, will, in the future, be based on rational analysis derived through integrated energy planning within a policy framework which seeks to advance social equity, economic competitiveness and environmental sustainability.

Current analyses indicate that nuclear power is more expensive than other electricity generating options such as clean coal or natural gas power stations or regional hydro-electric power. Given Eskom's existing overcapacity, it is unlikely that new electricity generating plant will be commissioned before the first decade of the next century and even if the next plant were nuclear, it is far from certain that Eskom will purchase fuel from the Atomic Energy Corporation.

The nuclear fuel operations of the AEC have been shown to be uneconomic and given the overwhelming demands on the fiscus, continued government subsidies for the AEC cannot be justified. Furthermore, Eskom will have to revise its current contract with the AEC which effectively provides an additional subsidy. A decision to unravel the substantial technological capacity that exists within the AEC cannot be taken lightly - an indigenous nuclear fuels industry cannot easily be recreated and many highly skilled personnel will lose their employment. However, a sober assessment of international markets, indicates that the AEC is unlikely to secure income to cover operating costs. Viable technological processes and products should be privatised and remaining technological competencies should be transferred to the CSIR and other research institutions. Applications for state support for technology development would be treated on merit within the general science and technology budget.

The activities of NUFCOR will be relatively unaffected by these policy interventions and they will be encouraged to concentrate on developing their export market for uranium oxides.

South African energy policy is being fundamentally reformulated. The pattern of energy investment in the apartheid era mirrored the disparities in provision of social infrastructure with the consequence that South Africa has a highly unequal distribution of income and access to basic services. The imminent and unprecedented representation in government of the majority of South Africans will inevitably lead to greater redistributive investment and government expenditure directed more at the basic needs of the poor. Indeed this has already begun. Growing international environmental concerns and the likelihood of environmental conditionality related to foreign investment and exports, and growing local health costs associated with pollution, will mean that energy policy will also have to promote environmental sustainability. And to grow a successful economy, South Africa has to become more competitive in manufactured exports. Low energy prices will assist that objective. These new imperatives mean that there is little room for continued subsidy of uneconomic sectors with little obvious social or environmental benefits. The nuclear industry in South Africa in the future will survive, only if it is able to do so without State support. As this paper shows, the nuclear industry, as represented by the nuclear fuels division of the AEC, is unlikely to meet this rational and reasonable challenge.

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