

# 1 The Development of Pretoria's Nuclear Industry and Relations with the IAEA, 1950–1977

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## 1.1 Into the Cold War: Uranium Mining and Atoms for Peace

During World War II, the South African Prime Minister J. C. Smuts was approached by US officials with a request to start conducting investigations into the uranium deposits of his country. The United States needed uranium ore for domestic demands, namely to accelerate nuclear weapons production. By 1948, studies showed that South Africa possessed this very rare mineral in abundance, as it occurred in almost every gold mine in the Witwatersrand area close to Johannesburg and was also later found in the boreholes of the Free State. Soon after, the South Africans erected uranium mining plants and in 1948 formed the Atomic Energy Board (AEB). Henceforth, all atomic matters became the responsibility of this board as its mandate included oversight of all nuclear-related activities in the country. Thereafter, with technical support from the United States and the United Kingdom, who also provided steel and other indispensable but scarce materials, several plants for mining uranium were constructed in the areas rich in natural uranium.<sup>1</sup> For a number of years, the AEB's focus was almost exclusively on the production and sale of uranium ore and regulatory tasks related to radioactive materials.<sup>2</sup>

Realizing the opportunity to generate more revenue in this sector, the South Africans increasingly sought to build up their domestic uranium industry. Due to US President Eisenhower's 'Atoms for Peace' programme initiated in 1953,<sup>3</sup> they were soon able to tap into sources of cooperation and funding to accumulate the knowledge necessary to set

<sup>1</sup> Newby-Fraser, 1979, p. 5.

<sup>2</sup> *Ibid.*, p. 31.

<sup>3</sup> Pilat, 2007. For an overview of how the United States promoted the promise of apparently peaceful nuclear technology to other nations and the inherent gamble of the latter being used for non-peaceful purposes, see: Hamblin, 2021, pp. 1–10.

up the domestic basis for nuclear and reactor physics.<sup>4</sup> However, even before Eisenhower's seminal speech in December 1953, US officials had signed a contract with the AEB for the purchase of uranium oxide over an extended period and free of safeguards in return for technical and scientific collaboration benefitting the young AEB. As part of the Atoms for Peace initiative a few years later, then under the so-called 'Plowshare Program', the United States entered into a formal ten-year nuclear cooperation agreement with South Africa. This was confined to cooperation for various peaceful uses of nuclear energy subject to safeguards and controls, to make sure that the US assistance did not further any military goals.<sup>5</sup>

Commercial uranium extraction commenced in 1952, closely followed by the commissioning of four additional uranium mining plants in 1953. Thereafter, production accelerated quickly and in 1959, twenty-six mines existed, feeding seventeen uranium milling plants. The entire output was designated for the Western world's nuclear armaments programmes, but after 1959, the uranium needs of these countries declined.<sup>6</sup> The United States was able to satisfy its uranium demand domestically after the discovery of uranium in the US southwest, and informed the AEB that it would stop buying foreign ore. To absorb the economic impact for suppliers such as South Africa, the United States entered into so-called bilateral 'stretch-out agreements', which ran until 1967. The AEB therefore had to find new customers to keep its nascent but growing uranium sector intact. Following the Sharpeville massacre in 1960 and South Africa's unilateral withdrawal from the Commonwealth a year later, this task became ever more difficult as fewer governments were willing to enter openly into contracts with the regime.<sup>7</sup>

In the meantime, domestic efforts to advance the growth of the atomic industry accelerated and politicians were keen to support its expansion. Until 1959, the young AEB was mainly endowed with a regulatory function, until on 5 September 1959, the South African Cabinet approved a nuclear research and development programme, which would change the character of the institution in the years to come. Renowned South African scientist A. J. A. Roux became its first research director, and his priorities

<sup>4</sup> Newby-Fraser, 1979, pp. 20–25; and Jaster, 1984, pp. 826–827. See also: Van Wyk, 2009.

<sup>5</sup> Van Wyk, 2007, pp. 197–200; Edwards and Hecht, 2010, p. 621. As Elisabeth Roehrlich has shown, the question of sharing nuclear knowledge and the resulting spread of know-how, which in turn could also be applied to non-peaceful uses, was prominently discussed between Soviet and US officials during the founding negotiations of the IAEA. The Agency's mandate included inter alia making the benefits of nuclear science available to 'the power-starved areas of the world', as per Eisenhower's 'Atoms for Peace' proposal (Roehrlich, 2016, p. 198).

<sup>6</sup> Brynard et al., 1988.

<sup>7</sup> Hecht, 2011, pp. 81–82.

included developing a cadre of nuclear scientists and engineers. To achieve this, the AEB started to send employees to selected overseas research institutions for basic nuclear training related to their scientific disciplines.<sup>8</sup> From 1960 onwards, senior staff members of the AEB made use of these new opportunities in advanced nuclear facilities in the United States. These measures helped overcome the lack of qualified nuclear scientists for ambitious research projects. Despite the availability of a small pool of scientists by 1959, none of them had undergone the necessary academic training in nuclear physics. Sending a cadre of scientists overseas to gain a wide range of experience seemed the only option:<sup>9</sup>

In fact, the whole pattern of the Board's research activities in the early years of the 1960s was an interwoven blend of construction activities, installation of equipment, active research and recruitment and training of staff, and by the end of the first five-year period a substantial range of research projects were already well advanced.<sup>10</sup>

Ultimately, this training proved instrumental in the establishment of a nuclear industry, especially in the early years of atomic research in the country, when nuclear physics and reactor physics were entirely new fields and the domestic research institutions were not yet in a position to contribute meaningfully.<sup>11</sup>

### *1.1.1 The Development of the Nuclear Industry: SAFARI-1*

In 1957, following the spirit of 'Atoms for Peace' and its Plowshare Program,<sup>12</sup> an agreement between the Americans and the South Africans provided for the acquisition of the South African Fundamental Research Installation-1 (SAFARI-1) research reactor to be constructed near Pretoria. Moreover, a contract was signed which stipulated that the highly enriched uranium (HEU) fuel for the reactor would be supplied by the United States as well.<sup>13</sup> Although South Africa had such rich uranium deposits, it had to import HEU as reactor fuel because at that time it did not possess the domestic capability to enrich uranium. Construction work on South Africa's first National Nuclear Research Centre at Pelindaba started in 1961, and the water-moderated, high-flux research and test reactor provided by the US firm Allis-Chalmers was erected.<sup>14</sup>

<sup>8</sup> Steyn et al., 2003, pp. 30–31.

<sup>9</sup> Newby-Fraser, 1979, pp. 54–56.

<sup>10</sup> Ibid., p. 62.

<sup>11</sup> Ibid., pp. 8–9.

<sup>12</sup> Stumpf, 2011, p. 135; and p. 138.

<sup>13</sup> Newby-Fraser, 1979, pp. 8–9.

<sup>14</sup> Van Wyk, 2007, pp. 197–200.



Figure 1.1 The opening ceremony of the SAFARI-1 research reactor in March 1965. On the far left in the control room is Prime Minister H. F. Verwoerd, next to Minister of Home Affairs 'Jan' de Klerk (F. W. de Klerk's father), and Minister of Mines Jan Haak, behind a smiling Betsie Verwoerd (National Archives, Pretoria).

*Source:* National Archives, Pretoria (South Africa)

A few years later, South African scientists started making use of their first domestic research reactor, the SAFARI-1, which was commissioned in early 1965 and went critical on 18 March 1965, almost a year later than initially scheduled due to problems related to the reactor vessel (see Figures 1.1 and 1.2).<sup>15</sup>

Despite deteriorating international opinion of South Africa following the consolidation of its discriminating apartheid policies, the cooperation with the United States, Pretoria's most important ally in the nuclear sector, continued unabated into the Johnson administration. Following the completion of the SAFARI-1 reactor, this relationship was again formalized in 1967 with the renewal of the cooperation agreement between the two states for another ten years, despite earlier signs of

<sup>15</sup> Newby-Fraser, 1979, p. 53; Stumpf 1995/96, p. 3.



Figure 1.2 Prime Minister H. F. Verwoerd welcomes international visitors together with AEB Chairman A. J. A. Roux (centre) at the opening ceremony of the first research reactor (in the background) at Pelindaba, in March 1965 (National Archives, Pretoria).

Source: National Archives, Pretoria (South Africa)

misgivings under President John F. Kennedy.<sup>16</sup> Thus, the South Africans could for the time being rest assured that HEU supplies would continue to keep SAFARI-1 operating. Nevertheless, early in the process of developing the South African nuclear infrastructure, it became apparent that the supply of fuel, such as HEU for the newly constructed reactor, was of primary concern. The apartheid regime remained dependent on overseas supplies to keep its nascent nuclear industry flourishing.

### 1.1.2 *South Africa and Its Relations with the IAEA*

In the late 1950s, South African representatives participated in the eight-nation negotiation group that was initially concerned with bringing into

<sup>16</sup> Van Wyk, 2007, pp. 197–200.

practice a global forum managing all things nuclear throughout the world.<sup>17</sup> South African delegates took part in this process because of the country's vast natural deposits of uranium. The eight-nation group officials connected the fact that a country was naturally endowed with vast uranium resources with technological advancement in the nuclear research field. This made South Africa one of the most powerful second-tier nations in the organization, behind the nuclear weapons states,<sup>18</sup> providing the country with more leverage in the negotiations than less privileged states could exercise in the future Agency.<sup>19</sup> According to Elisabeth Roehrlich, the country followed strategic goals here:

South Africa had succeeded in including the production of source materials in the formula for being 'most advanced' in the field of nuclear energy. This would guarantee the major uranium producer state South Africa, which could not hope for one of the elected seats given its isolation in the United Nations, quasi-permanent membership on the board.<sup>20</sup>

As a result of this diplomatic coup, it was no surprise that South Africa became a founding member of the IAEA in June 1957. At the same time, the South Africans used the same arguments concerning their technological advancement and extensive domestic nuclear research and development programme to position themselves as the most advanced state on the African continent. They did this in an attempt to bolster Pretoria's requests for a permanent seat on the IAEA Board of Governors.<sup>21</sup> They were successful in this regard and secured an influential position within the newly founded IAEA, the only international organization in which this increasingly criticized apartheid regime could hope to make a major impact.<sup>22</sup> As Roehrlich observed, South Africa's only feasible chance of being considered for the Board was to focus on the country's vast uranium deposits, because the members of the General Conference would otherwise never have elected the apartheid state to the Agency's Board. It therefore had to rely on the formula its diplomats had managed to include in the Agency's legal statute, namely the production of source material, as a marker of being 'most advanced' in the nuclear field.<sup>23</sup>

As the relationship between the South Africans and the IAEA developed over the second half of the 1950s, it became clear that it was both uneasy and conflictual. This was increasingly the case as more and more newly

<sup>17</sup> Roehrlich, 2016, p. 200.

<sup>18</sup> Hecht, 2006, p. 27.

<sup>19</sup> Roehrlich, 2016, pp. 201–202.

<sup>20</sup> *Ibid.*, p. 209.

<sup>21</sup> Hecht, 2011, p. 80.

<sup>22</sup> Hecht, 2006, p. 28.

<sup>23</sup> Roehrlich, 2022.

independent member states from the Global South joined the Agency, countries which for obvious reasons were highly critical of South Africa's apartheid system and challenged Pretoria's membership. However, the representatives from South Africa successfully maintained an influential position within the IAEA in the years to come, and with the helpful connivance of Western nations, the South Africans managed to defeat the Non-aligned Movement's (NAM)<sup>24</sup> efforts to deprive them of their Agency credentials. Right from the beginning, these early critical voices against continued South African membership in the Agency,<sup>25</sup> which mainly targeted the domestic apartheid legislation, came primarily from Indian, Egyptian and Soviet officials. Despite strong criticism of the IAEA's politicization by Pretoria's diplomats, this signalled that the Agency would not remain an apolitical international forum: it became clear that the wider Cold War framework could not be easily separated from the inner workings of the institution. In contrast, South African delegates repeatedly stressed their support for the IAEA's technical and apolitical character and wanted to maintain the Agency as a purely technical forum.<sup>26</sup>

The NAM countries in particular exerted pressure within the Agency, and from 1964 onwards, the South Africans embarked on what has been described as a 'collision course against the normative and legal IAEA framework'.<sup>27</sup> As a result, the climate within the IAEA became increasingly hostile towards the South Africans, and twenty nations signed the 'Declaration on the incompatibility of Apartheid with IAEA membership' in the mid-1960s. Delegates from the United States provided diplomatic support for South Africa via backchannels and helped fend off these early attempts to get South Africa's membership suspended. Washington defended Pretoria's continued Agency membership on grounds of the universality of member rights. Increasingly, the United Kingdom also extended its support to the South Africans within the IAEA.<sup>28</sup>

### 1.1.3 *The Nuclear Energy–Apartheid Nexus*

During the mid-1960s, it became obvious that one key impetus for Pretoria to develop and invest in the nuclear industrial complex was to strengthen the techno-nationalism advocated by the apartheid regime.

<sup>24</sup> The states that formed the NAM sought an alternative to alignment with one of the two superpowers, the United States and the Soviet Union, during the Cold War.

<sup>25</sup> Donald Bell Sole, South Africa's first representative at the IAEA, recalled in his memoirs the opposition against South African delegates within the Agency (Donald Bell Sole, undated, 'This above All: Reminiscences of a South African Diplomat', unpublished manuscript, p. 247).

<sup>26</sup> Hecht, 2006, pp. 27–31.

<sup>27</sup> Van Wyk, 2015, p. 399.

<sup>28</sup> Hecht, 2006, pp. 40–48.

Therefore, progress on the nuclear scientific front served another function beyond the satisfaction of domestic energy needs (and later the production of HEU for the bombs), namely to uphold and cement the conviction that the Republic could indeed carry out a modern scientific project and further the development of the nuclear industry in the interest of the whole country. This task stood in stark contrast to the underdeveloped rest of the African continent, in Pretoria's logic. Therefore, apartheid and its separate development doctrine could be justified by invoking the dichotomy of a well-advanced industry in the hands of a small white elite and a backward and non-scientific *African* other. Gabrielle Hecht and Paul Edwards claim that 'critical to the apartheid state and its industrial elites was a nationalist, technological history that simultaneously allied South Africa with the West and maintained its exceptionalism [on the African continent]'.<sup>29</sup> The uranium industry was perfect for articulating this narrative. Globally, atomic science and technology had assumed centre stage of modernity and became an important means to achieve, also in terms of geopolitics.<sup>30</sup>

By the mid-1960s, the various factors that encouraged technological development as well as the international isolation of the apartheid state had jointly guided South African scientists into the next phase of nuclear development. It is here that a confluence of factors came to the fore: on the one hand, commercially oriented nuclear research activities, set in motion by the export of South African uranium in the 1950s, and on the other hand, the deterioration of the security situation as perceived by the decision-makers in Pretoria.<sup>31</sup>

#### 1.1.4. *Aiming High: Plans for Domestic Uranium Enrichment*

In the 1960s, the AEB set out to master the next step in the nuclear fuel cycle, namely to enrich processed uranium ore and thus turn it into fissionable material as fuel for nuclear power reactors.<sup>32</sup> Coinciding with the return of overseas-trained scientists and engineers to South Africa, which greatly augmented its knowledge base, the AEB almost immediately proposed to pursue two ambitious research projects in parallel to become independent from overseas expertise: the development of an

<sup>29</sup> Edwards and Hecht, 2010, p. 621. Van Wyk has called this 'nucleo-nationalist ambitions' (Van Wyk, 2015, p. 401).

<sup>30</sup> *Ibid.*, p. 621. Hecht and Roehrllich show how having a more developed national nuclear sector brought greater leverage in the talks leading up to the creation of the IAEA and the composition of its Board of Governors. Roehrllich has termed this 'atomic colonialism' (Roehrllich, 2016, p. 18), whereas Hecht referred to the same phenomenon as 'nuclear ontologies' (Hecht, 2011, pp. 75–76).

<sup>31</sup> Van Wyk, 2018, p. 1155.

<sup>32</sup> Edwards and Hecht, 2010, p. 623.



indigenous enrichment process and a reactor concept, using natural uranium as fuel.<sup>33</sup> Ultimately, the South African government opted for the first project. It prioritized plans to develop its nascent nuclear infrastructure so that it would be possible to enrich uranium domestically and achieve self-sufficiency concerning fuel supply, which was important due to the growing international isolation of the apartheid regime.<sup>34</sup> According to the official AEB account of this time, the reactor project as well as the enrichment project had reached a stage where considerable financial investment was needed to carry on with both projects simultaneously. Given the financial dimensions of the two projects and governmental budget constraints, the Cabinet decided to abandon the reactor project in favour of channelling the available resources into research on uranium enrichment, ultimately aimed at developing an indigenous process.<sup>35</sup> The underlying rationale was that South Africa, then one of the most important uranium producers globally, would benefit from the lucrative possibility of increasing the value of natural uranium by enriching it as well as using it as fuel for domestic reactors.<sup>36</sup> Thus, the enrichment of uranium was deemed of greater importance for the Republic in the near future than the development of an indigenous reactor concept, as it would enable the South Africans to break free of foreign low-enriched uranium (LEU) and HEU<sup>37</sup> sources.

What tipped the decision in favour of continuing the exploration of the South African enrichment method was that by late 1967, the feasibility of the so-called vortex-tube enrichment, which resembled the centrifuge enrichment process, had satisfactorily been demonstrated on a laboratory scale. This led to the Cabinet voting in favour of the construction of a pilot plant intended to precede the development of a full-scale commercial enrichment complex sometime in the future.<sup>38</sup> Thus from the very beginning, the technical purpose of the pilot plant (Y-plant) was to form the basis for planning a much larger commercial enrichment plant if the research showed that domestic uranium enrichment could be competitive with foreign processes. Therefore, in hindsight, the pilot project was endowed with a twin purpose: while the main task was to produce HEU for the SAFARI-1 research reactor and eventually for the

<sup>33</sup> Von Wielligh and von Wielligh-Steyn, 2015, pp. 110–111. The latter was called the 'Pelinduna Project'.

<sup>34</sup> Fig, 1999, p. 81.

<sup>35</sup> Steyn et al., 2003, pp. 34–35. See also Stumpf, 2011, pp. 138–139.

<sup>36</sup> Newby-Fraser, 1979, pp. 92–93.

<sup>37</sup> Highly enriched uranium contains 20 per cent or more U-235; it is therefore considered proliferation sensitive whereas LEU is not. Both are fissionable materials. Low-enriched uranium is mostly used as reactor fuel.

<sup>38</sup> Newby-Fraser, 1979, pp. 92–93; Waldo Stumpf, 2011, pp. 138–139.

weapons programme that took off a little later, the second objective was to test-drive the technology of the vortex tube enrichment process that South African scientists were investigating at that time.<sup>39</sup>

Shortly thereafter, on 20 July 1970, Prime Minister B. J. Vorster informed the world that South African scientists had developed a process to produce HEU. He elucidated that a pilot plant would be built to prove the process beyond a laboratory scale, pointing out that the government had plans to ultimately build a much larger commercial enrichment plant. The reason for this, Vorster claimed, was to add value to locally mined uranium and to save money on having it otherwise enriched overseas.<sup>40</sup> At the same time, Vorster said that his government would use these new technologies for peaceful purposes only and would be open to discussing a possible signature to the NPT with interested parties.<sup>41</sup> However, in the wake of Vorster's announcement, Pretoria's continued unwillingness to accede to the NPT increasingly proved a conundrum for South Africa's Western partners.<sup>42</sup>

Following Vorster's announcement, in November 1970, the Uranium Enrichment Cooperation of South Africa (UCOR) was founded, and A. J. A. Roux became its chairman. The scientists of the AEB, who had previously worked on uranium enrichment, started working for the new company, but the two organizations retained a high level of cooperation, not least because their premises were adjacent to each other. Moreover, the construction of the pilot Y-plant at Valindaba began in August 1971, exactly a year after Vorster's speech.<sup>43</sup> Characteristic of UCOR's first years of existence was the construction of the pilot enrichment plant, which became operational in May 1975. Pretoria announced that thanks to the operation of this plant, UCOR would soon be able to market uranium internationally for a third of the US price. The South Africans began looking for buyers on a global scale.<sup>44</sup>

## 1.2 The NPT's Article IV and South Africa's Position on the Treaty

By the mid-1960s, the number of nuclear weapons states had increased to five and there were fears that dozens more would appear. The international community perceived the fundamental need to prevent any

<sup>39</sup> Stumpf, 2011, pp. 138–139; Van Wyk, 2007, pp. 197–200.

<sup>40</sup> Fig, 2005, p. 31.

<sup>41</sup> Newby-Fraser, 1979, pp. 91–92; p. 95. The full speech in Parliament by Vorster on 20 July 1970 was given in English for the benefit of foreign visitors and journalists.

<sup>42</sup> Van Wyk, 2018, p. 1155.

<sup>43</sup> Newby-Fraser, 1979, pp. 103–104.

<sup>44</sup> *Ibid.*, pp. 91–92; 95.

further spread and negotiated an international treaty that curbed nuclear proliferation on a global scale.<sup>45</sup> The NPT, which became open to signature for IAEA member states in 1968, reiterated and strengthened the IAEA's authority and required that all states should accept and apply international safeguards to all its nuclear activities.<sup>46</sup>

From Pretoria's point of view, the most important of the eleven articles of the NPT was Article IV, as it regulated the exchange of nuclear technologies for peaceful purposes among the signatories of the Treaty. Pretoria's leaders were overly concerned that they would not receive the same treatment as other IAEA member states under this article, in part due to the international criticism of apartheid. Article IV affirms that the benefits of

peaceful applications of nuclear technology, including any technological by-products which may be derived by nuclear-weapons States from the development of nuclear explosive devices, should be available for peaceful purposes to all Parties to the Treaty, whether nuclear-weapon or non-nuclear-weapons States. [Hence, all parties are entitled to] participate in the fullest possible exchange of scientific information for, and to contribute alone or in co-operation with other States to, the further development of the applications of atomic energy for peaceful purposes.<sup>47</sup>

From the very beginning of the discussions that led to the conclusion of the NPT, however, representatives of the non-nuclear-weapon states pointed out that Article IV provided no absolute guarantee that the benefits of atomic research and nuclear energy would become available to all states equally.<sup>48</sup> Such overtures made South African delegates suspicious as to whether they could reap the benefits of nuclear cooperation, which from their perspective had to offset the reduced domestic nuclear sovereignty that followed NPT accession. By the time the Treaty entered into force on 5 March 1970, South African scientists had already achieved much domestic progress and a large research and development programme was under way. They therefore wanted to minimize external oversight of their nuclear industry, a goal contrary to the spirit of the NPT. Moreover, the imposition of IAEA safeguards on atomic installations worried Pretoria officials, who claimed that commercial secrets would leak and find their way to competitors, which would ultimately affect the worldwide marketability of South African uranium.<sup>49</sup>

<sup>45</sup> Roehrich, 2022, pp. 107–129. For another in-depth account, see also: Popp et al., 2017.

<sup>46</sup> Van Wyk, 2015, pp. 399–400.

<sup>47</sup> Shaker, 1980, p. 273.

<sup>48</sup> *Ibid.*, p. 278.

<sup>49</sup> Hecht, 2006, p. 42.

Following the inception of the NPT in 1968, the South African government challenged the emerging nuclear order from the outset by foregoing signature to the Treaty and not placing crucial parts of its nuclear infrastructure under IAEA safeguards. South Africa's persistent refusal to sign the NPT encountered much international criticism within the IAEA in the 1970s. This effectively put the country's nuclear installations beyond the reach of the new IAEA safeguards regime, except SAFARI-1, which fell under a trilateral US–IAEA–South African safeguards agreement.<sup>50</sup> All things considered, Pretoria's leaders maintained the view that there was not much to gain under the new Treaty. With the rise of international criticism targeting the apartheid regime's racial policies, it was clear that resistance to nuclear technology sharing with South Africa would be extremely difficult to overcome. Yet well into the 1970s, secret Western support was still forthcoming. It can thus be argued that it was unnecessary for the South Africans to sign the NPT for the sake of Article IV benefits, because enough cooperation was available in this period.

### **1.3 From 'Atoms for Peace' Beneficiary to a Global Nuclear Actor**

During the early years of the atomic sector in South Africa, collaboration and access to foreign technology was mostly obtained through the United States and the United Kingdom. Right from the late 1950s and early 1960s, this enabled local scientists to develop their own expertise via research trips to US and European nuclear installations.<sup>51</sup> However, following the rise of voluntary embargoes and later the binding sanctions that started to hit in the 1970s, the South African nuclear industry was forced to become increasingly self-reliant. The industry nonetheless still had to import many items necessary to progress with their ambitious plans, and South African scientists therefore established secret networks with links abroad to obtain the much-needed supplies. The use of these backchannels enabled them to alleviate the impact of sanctions and to

<sup>50</sup> The SAFARI-1 research reactor was initially under a bilateral safeguards agreement with the United States from March 1965, because back then the IAEA did not yet have a model agreement and the NPT had not yet entered into force. It was only in late 1965 that the IAEA approved a model agreement (INFCIRC/66) and the US administration was able to transfer oversight of the reactor to the Agency eleven days later (Von Wielligh and Von Wielligh-Steyn, 2015, pp. 109–110). For an additional account, see: Olli Heinonen, 2016, p. 148.

<sup>51</sup> Fuhrmann 2012, pp. 158–159.

secure dual-use equipment such as machine tools and furnaces for their nascent industry.<sup>52</sup>

From the very beginning, these links with European governments also included another dimension that went beyond the training provided for South African scientists. Starting in the late 1950s, the South African authorities regularly sent delegations of AEB representatives all over Europe to explore the demand for uranium on the continent and to forge relationships with potential customers. These international connections proved incredibly useful in the developmental stages of the South African nuclear industry, both in terms of providing a constant stream of revenue as well as offering a source of scientific know-how and technology. A. J. A. Roux, head of the AEB, made this point when he acknowledged in 1976 that the early nuclear assistance given by the Americans especially, referring to overseas training of South African scientists, had proved indispensable.<sup>53</sup> Indeed, a major characteristic of the US–South African relationship was that Washington considered the apartheid regime to be an important ally during the Cold War. However, especially after P. W. Botha's rise to power, domestic racial policies in South Africa had a marked effect on the mutual relationship, turning US domestic opinion increasingly against the apartheid state. Nonetheless, under successive US presidents, the view that South Africa was strategically important for the West still prevailed in Washington's decision-making circles. This encompassed matters such as trade, cooperation and commercial partnerships, clearly showing that Cold War and military interests ranked high in various US administrations during the 1960s and 1970s.<sup>54</sup>

### 1.3.1 *A Transnational Nuclear Network: German and French Connections*

Right from the early planning stages, leading officials in the South African nuclear energy circles realized that initiating large-scale projects would not be possible without considerable foreign investment. In that regard, the relationship between South Africa and Germany is of importance, because a number of German firms and research institutions from the energy sector entertained relations with their counterparts in the apartheid regime. This dated back to the 1960s and included most prominently the Steinkohlen-Elektrizitäts AG (STEAG) based in

<sup>52</sup> Fig, 2005, p. 47.

<sup>53</sup> Fig, 1999, p. 80.

<sup>54</sup> Rabinowitz 2014, pp. 107–109.

Essen, the Gesellschaft für Kernforschung (GfK) in Karlsruhe and the Kraftwerk Union (KWU) in Duisburg. At the same time South African energy officials reached out to the French atomic industry as well, trying to find the financially most promising option offered by their European partners. This included careful consideration of what technology was needed and what was possible to obtain in light of the deteriorating international climate towards the apartheid regime, which greatly limited the available options and the will of potential partners to act in support of Pretoria. Secret means of technology exchange became one important way to obtain nuclear know-how.<sup>55</sup>

By the mid-1970s, the South African scientists had advanced quickly and made progress towards enriching uranium domestically. With the Y-plant scheduled to become fully operational towards the end of the 1970s, they set out to build a much bigger plant on a commercial scale. The Z-plant, as it became known, was intended to produce the LEU needed for a planned nuclear power station once it began producing nuclear energy at some point in the 1980s.<sup>56</sup> In order to find out if the South African enrichment process was suitable for use in such a large-scale plant, coupled with the twin objective of convincing possible overseas partners to invest in such an enterprise, UCOR entered into feasibility studies with overseas energy companies, some of which remained secret.<sup>57</sup>

To ensure progress and financial support, UCOR officials were also involved in discussions with the French Commissariat à l'Énergie Atomique (CEA) regarding a partnership subject to a formal intergovernmental agreement. This included joint feasibility studies of the new enrichment process, with a view to using this method in the enrichment plant, provided it was competitive with other processes available at the time, such as the gaseous diffusion uranium enrichment method used by the CEA. Ultimately, this endeavour resulted in the building of a large commercial enrichment plant in South Africa, according to their ambitious plans. Adopting a long-term view, AEB officials also hoped to secure indispensable foreign investment for the construction of the plant, which would use the UCOR process provided it proved competitive. On the other hand, the South Africans would share their knowledge with the CEA in return for political protection of the whole endeavour. However, about a year later in 1971, the French government indicated to Pretoria that it would not conclude an agreement for the joint

<sup>55</sup> Van der Westhuizen and Le Roux, 1997, pp. 312–315.

<sup>56</sup> Stumpf, 2011, pp. 138–139.

<sup>57</sup> Helmut Völcker (STEAG), personal correspondence, September 2019, via email.

exploration of the South African enrichment process, as it had decided to join its European partners in the exploration of another enrichment option based on gaseous diffusion, as pursued by the European Atomic Energy Community (EURATOM). This precluded any collaboration between the French nuclear industry and Pretoria at that stage, because it would have required Paris to follow two different enrichment processes. The decision to abandon cooperation with the South Africans was also influenced by political considerations, because if French authorities had agreed to a joint endeavour, a large-scale enrichment plant would most likely have been erected in South Africa. Being seen to be in close cooperation with the apartheid state would have caused a setback to France's relations with its former colonies, now independent nations, on the African continent.<sup>58</sup>

The French thus proved unwilling to collaborate, but the German channel pursued in parallel by the South Africans proved initially more responsive, as STEAG was generally willing to engage in joint feasibility studies, despite an apparent lack of political will in Bonn to support the project. STEAG's interest in engaging in joint feasibility studies with UCOR revolved around the chance to prove the viability of its process under concrete conditions beyond a laboratory scale.<sup>59</sup> Ultimately, the more promising of the two processes would be used in any future plant to be built in South Africa. While STEAG and the GfK were eager to further develop and refine their enrichment process in a joint study with the AEB, the German government was hesitant and played for time.<sup>60</sup> Despite these limitations, the joint comparative studies went ahead and upon conclusion in 1974, the results showed that there was not much difference between the two processes. This was enough for UCOR to go ahead unilaterally. The performance data were made available to the Germans, but the sensitive data of the separative elements in the UCOR process were withheld and treated as a black box. This was because STEAG's officials would have needed to sign a declaration of secrecy to access the sensitive data, but they were unable to do so due to political reasons.<sup>61</sup> The decision by UCOR to proceed unilaterally was probably also influenced by the likelihood of resistance within the German Cabinet, so that the AEB leadership opted for the local process because its availability was not subject to changing political liabilities.

<sup>58</sup> Van Wyk, 2018, pp. 1156–1157.

<sup>59</sup> Helmut Völcker (STEAG), personal correspondence, September 2019, via email.

<sup>60</sup> Romberg, 2020, pp. 240–242.

<sup>61</sup> Helmut Völcker (STEAG), personal correspondence, September 2019, via email.

### 1.3.2 *The Z-Plant in Need of Foreign Investment: Talks with STEAG and the CEA*

With the pilot plant almost fully completed by the mid-1970s, and having made general progress in upgrading the nuclear energy sector with the help of foreign cooperation, South African energy officials aimed higher and set out to make financially lucrative use of the advanced state of their domestic nuclear infrastructure. This included marketing the gaseous diffusion enrichment process they claimed to have discovered. By early 1975, sufficient technical progress had been achieved to enter into concrete discussions on a large-scale enrichment plant with potential investment partners.<sup>62</sup>

As a first step, the goal was to advance the secret discussions with the CEA and STEAG officials and secure a preliminary agreement to jointly build a commercial plant, not to merely conduct feasibility studies as a few years before. Therefore, presenting UCOR's enrichment method at a prominent venue was perceived as crucial for obtaining the much-needed financial investment from interested partners. The European Nuclear Conference taking place in Paris in April 1975 presented the perfect venue. In the event, a dual approach was pursued by the South African delegates in the French capital: scientific results were shared in academic circles and at the same time efforts were made to interest possible partners in the proposal for a large-scale nuclear project which the South Africans could not financially manage alone. During the conference, AEB Chairman Roux delivered a paper called 'Uranium Enrichment in South Africa', which he claimed lifted the veil on the process slightly. In particular, regarding the information he carefully made available to the public, Roux remarked that: 'we had to adopt a cautious approach in the paper so that we revealed just enough about the process to arouse interest and secure a place for South Africa on the commercial enrichment front without revealing our valuable secrets and reducing our advantage'.<sup>63</sup> After the official part of the conference, Roux and Wally Grant, Chairman of UCOR, continued to hold a series of secret meetings with representatives of STEAG and the CEA.

These talks in 1975 concerned financial investment for the large-scale enrichment plant envisioned by the South Africans, as they hoped that STEAG would provide the much-needed foreign investment whereas

<sup>62</sup> Newby-Fraser, 1979, p. 105.

<sup>63</sup> 'The South African Enrichment Process and Reaction from overseas before and at the European Nuclear Conference, Paris, held from 21 to 25 April, 1975', 14 May 1975, PV476, File: 1/7/13/1/1, Archive for Contemporary Affairs (hereafter ARCA).



UCOR would contribute the necessary technology.<sup>64</sup> Like STEAG, the CEA had earlier been similarly involved in determining the quality of the South African enrichment process. Already in February 1974, the CEA and AEB/UCOR had entered into an agreement that led to a joint feasibility study on the prospects offered by a large industrial application of UCOR's uranium enrichment process. The results of this study were passed on in February 1975 by the CEA to AEB/UCOR.<sup>65</sup> The two sides agreed that further cooperation would have to take place in absolute secrecy, as had been the case in the past. This secrecy could hardly be maintained if STEAG were to partake in the construction of a large-scale enrichment plant in South Africa, because the UCOR scientists would then eventually have to disclose the secret cooperation of another potential partner to them, namely the CEA.<sup>66</sup>

By way of summarizing the meetings with the German and French delegations, A. J. A. Roux concluded that on the one hand, STEAG had declared that it was prepared to take up the anticipated stake of 20 per cent in the planned company 'Uranium International', subject to certain conditions, which still had to be specified. On the other hand, the French CEA had made it repeatedly clear that 'STEAG's participation remained a fly in the ointment'<sup>67</sup> and that for competitive reasons, any deal involving STEAG and a possible trickle-down of CEA's knowledge to its German competitor, could end the CEA's involvement. In any case, at that point in late May 1975, both proposals still lacked approval by the French and German governments, which was a precondition for Pretoria's officials to enter into any cooperation on the future Z-plant, in order to alleviate fears that either the CEA or STEAG would not fulfil their obligations in the costly endeavour. As he was unsure what to make of these exchanges with the two parties, Roux eventually recommended that UCOR should wait for a revised STEAG proposal and, if this were not acceptable, then enter into further negotiations with the CEA.<sup>68</sup>

Interestingly, newly obtained archival documents show that the discussions between the three potential partners went way beyond exploring the practicability of a commercial enrichment plant, as had been officially

<sup>64</sup> *Ibid.*

<sup>65</sup> *Ibid.*, Appendix B, 2 April 1975. In addition, as Van Wyk has shown, French and South African officials had already considered a formal intergovernmental agreement to jointly exploit the newly developed South African uranium enrichment process in 1971. However, this did not materialize at that point (Van Wyk, 2018, p. 1156).

<sup>66</sup> 'The South African Enrichment Process and Reaction from overseas before and at the European Nuclear Conference, Paris, held from 21 to 25 April, 1975', 14 May 1975, PV476, File: 1/7/13/1/1, Appendix B, 2 April 1975, ARCA.

<sup>67</sup> *Ibid.*

<sup>68</sup> *Ibid.*

acknowledged by their governments. Instead, UCOR and STEAG went as far as producing a detailed draft agreement laying out the risks and financial benefits, such as the price for which STEAG could eventually purchase enriched uranium from the new plant.<sup>69</sup> However, in the absence of support (and commitment) from STEAG, the South Africans nevertheless decided in 1975 to build a new enrichment plant with an estimated capacity of five million separative work units (SWU) per annum, although they then drastically reduced the project due to the lack of foreign capital. In the end, the South Africans settled with building a semi-commercial enrichment plant with 300,000 SWU/year, less than 10 per cent of the originally planned capacity, but still a size deemed sufficient to provide enough LEU for the two Koeberg reactors under construction. Hence, the plant was intended to serve only domestic purposes.<sup>70</sup>

It is quite striking that the official AEB account did not reveal how the lack of a supporting industry to build such a plant was overcome, although this had been regarded as a huge obstacle earlier. Even with a smaller plant, which meant less financial investment, the principal technological challenges remained the same, albeit on a much reduced scale. Instead, South African accounts based on personal recollections usually portray their industry as having already been competent enough in 1979 to produce these vital components.<sup>71</sup> This was a gross simplification of the situation, because many parts of the Z-Plant had to be imported from foreign suppliers at high cost as the erection of the plant commenced. Generally, the main driver behind the development of a domestic nuclear infrastructure was to achieve a level of independence from foreign sources of support, in particular enriched uranium. After about five years of running the research reactor SAFARI-1 at full power, the political climate had worsened from South Africa's perspective and it was decided to reduce the power output of the reactor to 5 MW (instead of 20 MW) in order to save fuel. Due to international opposition towards the apartheid state's racial policies, the uninterrupted supply of nuclear fuel from allies in the Western world could then no longer be taken for granted, least of all dual-use technology. However, running the reactor at reduced capacity impacted the speed and scope of the ongoing research projects carried out by the AEB.<sup>72</sup>

<sup>69</sup> 'The South African Enrichment Process and Reaction from overseas before and at the European Nuclear Conference, Paris, held from 21 to 25 April, 1975', 14 May 1975, PV476, File: 1/7/13/1/1, Appendix A, 21 April 1975, ARCA.

<sup>70</sup> Albright and Stricker, 2016, pp. 60–61.

<sup>71</sup> Newby-Fraser, 1979, pp. 111–113.

<sup>72</sup> *Ibid.*, pp. 54–55.

### 1.3.3 *The Koeberg Power Reactors and the Tender Process*

What was still missing from the South African nuclear landscape was a nuclear reactor to produce energy, and with the AEB's earlier reactor project shelved in favour of the enrichment plans, there was no chance of a domestic solution to fill this lacuna. Therefore, parallel to building the commercial enrichment plant, the South Africans tried to obtain a power reactor for electricity production to meet the country's increasing energy demands. However, South Africa lacked the necessary industrial prowess to build such a reactor, in terms of capable people and of a relevant industrial base. Carrying out such a sophisticated project was clearly beyond the capacity of the domestic nuclear sector, and an international tender was set up. Therefore, once more during the 1970s, German–French competition over nuclear cooperation with the apartheid state flared up, following the AEB's announcement of a tender for its planned nuclear power station at the Atlantic Ocean north of Cape Town, near a town called Koeberg. Initially, three shortlisted consortia submitted bids for the contract, but a Dutch–US–Swiss group failed to provide the requested governmental guarantees and dropped out. This left only two parties in contention: the German Kraftwerk Union (KWU) and a French-led consortium of Framatome-Alsthom-Spie-Batignolles.<sup>73</sup>

It was generally perceived that the stronger of the two bids came from the German firm KWU. However, to export nuclear reactors to the apartheid regime, the German government had to consider a multitude of factors including its commitments as an NPT signatory as well as financial aspects, not to mention political repercussions arising from cooperation with the South Africans. In contrast, the French consortium Framatome-Alsthom-Spie-Batignolles, which in 1977 eventually won the tender, was politically backed by the French government, as Paris was not then a signatory of the NPT. KWU officials were left to lament the lack of political support from the German government.<sup>74</sup> While in 1975 French officials did not manage to conclude a deal with Brazil, to the benefit of West German energy firms who eventually won the contract to build reactors,<sup>75</sup> the French nuclear complex achieved its goal in South Africa: it emerged as the successful party and constructed the Koeberg power plant.<sup>76</sup>

Regarding the overall support from Bonn for KWU's bid, Romberg argues that in the case of the Koeberg tender, the German government

<sup>73</sup> Fig, 1999, pp. 91–93.

<sup>74</sup> Helmut Völcker (STEAG), email message to author, September 2019.

<sup>75</sup> Patti, 2022, pp. 81–95.

<sup>76</sup> Adamson, 2022, pp. 334–335.

did not really go out of its way to support the application. While it rather reluctantly provided an export credit guarantee for KWU in 1975, it was generally too constrained by domestic and international opposition to apartheid, which prevented substantial nuclear cooperation with the government in Pretoria. The leadership in Bonn did not want to be seen as openly cooperating with South Africa on a governmental level. Therefore, when the tender was awarded to the French consortium, the German government was apparently not too disappointed that KWU's bid had been unsuccessful.<sup>77</sup> It was widely believed that the decision between the only two contenders left would be made on technical grounds, albeit subject to possible political considerations. Apparently, scientists from the Electricity Supply Commission (ESKOM) in South Africa, who had visited Germany in April 1975, were convinced that the German offer had an edge over the French bid regarding its technical merits, whereas the French consortium provided slightly better financial conditions. However, ESKOM scientists argued that this would be outweighed by Germany's firm reputation of being able to deliver on a due date, unlike the French who had earlier failed to supply Iran with a reactor on time.<sup>78</sup>

Given the underlying political considerations, it was concluded that 'South Africa would hesitate to put even more eggs into the single French basket than that basket already holds' and the government as well as ESKOM were acutely aware of the need for 'diversification in the interest of South Africa's long-term future'.<sup>79</sup> This very same argument was a valid one in view of threats emanating from the French side that there could be cuts in the provision of French armaments if the Koeberg contract were not awarded to the French consortium. However, according to the South Africans, the French arms industry would sell its weapons regardless of the outcome of the Koeberg tender, as long as it was in their financial interest to continue with weapons sales. Therefore, 'threats of the nature referred to should be taken as a fundamental and indeed legitimate aspect of French negotiating techniques'.<sup>80</sup> This indicated that a whole web of factors had to be considered and that it was not just technical merits that tipped the decision-making scales.

With a view to the political developments in both countries, the South African side forecast that after the 1978 French general election a

<sup>77</sup> Romberg, 2020, pp. 258–259; and p. 272.

<sup>78</sup> Report, 'Reactions in Germany to the award of the Koeberg Contract to Framatome-Alstom-Spie-Batignolles', 17–19 June 1975, file PV528 MB 3/2/2 Vol. 29, Minister of Foreign Affairs, Visit to Foreign Countries, ARCA.

<sup>79</sup> Ibid.

<sup>80</sup> Ibid.

Socialist–Communist coalition would come to power, which harboured the danger of the new government rescinding the guarantees and undertakings provided by the present French government. In Germany, on the contrary, an election was scheduled for autumn 1976, but this was not seen as a threat. It seemed likely that the present guarantees given by the incumbent administration would be upheld if it were re-elected. Furthermore, if the opposition parties emerged victorious, a new government would most likely be even more favourably disposed towards South Africa. In this scenario, with a conservative CDU/CSU coalition in power, the risk of Bonn's government renegeing on existing contracts was virtually non-existent. In the end, however, despite the better technical and political options inherent in the KWU offer, the South African government decided to award the tender to Framatome, which apparently could only provide a slightly better financial package.<sup>81</sup> It is still unclear what precisely influenced this decision, but given the long-standing relationship encompassing the nuclear-military nexus between Paris and Pretoria, it seems likely that the motives are hidden somewhere in the lesser-known areas of this connection. At a time when multilateral export control mechanisms such as the Nuclear Suppliers Group (NSG) and the Zangger Committee were not yet fully established and, thus, international non-proliferation policies were still relatively weak, the French nuclear industry, and foremost the CEA, aimed at securing lucrative overseas contracts.<sup>82</sup>

#### 1.4 Towards the Late 1970s: South Africa Finds Itself Alone – But Well-Equipped!

From the early 1970s, the South Africans tried to find partners to finance a joint commercial-scale uranium enrichment plant. This included encounters with delegations from France, Germany, Italy and Japan who were interested in entering into lucrative deals to obtain enriched uranium from South Africa in return.<sup>83</sup> The confluence of attempts to establish UCOR as an important global supplier of enriched uranium

<sup>81</sup> Ibid.

<sup>82</sup> Sarkar, 2020, p. 317. For more information on the importance of France for the apartheid regime as a source of weapons, see also van Vuuren, 2017, pp. 209–256. Konieczna claims that South African sources suggest that the CEA's secret consultancy to UCOR/AEB could have been linked to the attribution of the tender to the Framatome consortium (Konieczna, 2021, p. 11).

<sup>83</sup> 'Letter to Cesidio Guazzaroni from Carlo Salvetti', 4 April 1972, Comitato Nazionale per L'Energia Nucleare (CNEN). I am indebted to Dr Giordana Pulcini (Roma Tre University) for sharing and translating this document. Towards the late 1970s, attempts were made to enter into cooperation with Brazil (Patti, 2018, pp. 1–17).

fuel and growing international criticism of the apartheid regime warrants further scholarly enquiry in the future. As discussed earlier in this chapter, South African atomic scientists and engineers won support internationally, despite the fact that the overall global political climate for the apartheid regime deteriorated rapidly in the wake of the Soweto riots in 1976. This hindered Western countries from entering into long-term cooperation contracts with South Africa.<sup>84</sup>

However, over the years, the AEB did not solely rely on its own industrial base. It was later acknowledged during internal discussions that foreign sources were indeed still forthcoming with supplies of technological expertise via backchannels, despite embargoes to prevent the apartheid state from acquiring these items.<sup>85</sup> While it would be speculation to name one or several companies as possible suppliers, there is reason to believe that the deals between the CEA and UCOR discussed above were eventually carried out, at least to some degree.<sup>86</sup> This brings French firms operating in the nuclear-energy nexus into the spotlight, and future research to disentangle the military-atomic relations between Paris and Pretoria will be of crucial importance. Indeed, as Hecht has observed, ‘the South African uranium industry operated in a space delineated by entanglements between the politics of market capitalism and those of global Cold War’.<sup>87</sup> In fact, the relations with the apartheid regime served Western states equally well, as uranium continued to flow north long after sanctions and embargoes were introduced and concrete evidence of Pretoria’s nuclear weapons programme had surfaced. Moreover, this is a prime example of how European companies, especially of German and French origin, were eager to enter into close cooperation with the apartheid regime, thereby undermining international efforts to prevent South Africa from becoming a nuclear weapons state. And while the South Africans had to limit their plans of commercializing the enrichment of uranium in the late 1970s due to a lack of foreign capital, they nevertheless produced enough HEU for strategic-military purposes. In fact, the earlier cooperation and joint studies with French and German partners had given UCOR’s scientists

<sup>84</sup> Newby-Fraser, 1979, pp. 111–113.

<sup>85</sup> ‘Safeguards on the Semi-Commercial Enrichment Plant of the AEC: Resolution against South Africa at the General Conference of the IAEA, September 23–29, 1985’, 7 October 1985, PV203, File: PS 6/13/3, ARCA.

<sup>86</sup> Newly unearthed correspondence records between Pretoria and Paris reveal that French firms continued cooperating with South Africa, despite changes of government in France (Koniczna, 2021, pp. 297–299).

<sup>87</sup> Hecht, 2011, p. 91.

confidence and enabled them to build elaborate nuclear infrastructure, which served their domestic purposes until the end of apartheid.

The perceived threat resulting from the deterioration of the regional security situation in the wake of the crumbling of the Portuguese colonial empire and Pretoria's pariah status necessitated a change of strategy, so that open collaboration in the nuclear sector was replaced by secret cooperation with those firms still willing to engage with the South Africans. After entering the international scene as an important supplier of the uranium ore needed by the United Kingdom and the United States to cater for their domestic demands, the development of the South African nuclear energy sector for peaceful purposes was for years bolstered by Western cooperation.<sup>88</sup> However, during the 1970s, after South African scientists had established solid domestic nuclear infrastructure, there was a marked shift towards more sophisticated plans including the mastering of the front-end nuclear fuel cycle, not least because enriching uranium seemed a major potential source of income at that time.<sup>89</sup> Progress to this end would also free South Africa from the dwindling international options for nuclear cooperation and fuel deliveries from overseas. Thus, under the utmost secrecy, the South African government and its scientists worked towards obtaining the necessary atomic infrastructure. This formed the basis for the nuclear weapons programme that commenced in the second half of the 1970s.

Ultimately, however, while almost desperately seeking overseas cooperation and access to global markets during the 1960s and 1970s, the growing international opposition to apartheid prevented the regime's establishment as an important nuclear fuel supplier on the world market. South African defiance of non-proliferation norms following the inception of the NPT and the resulting ambiguity around their nuclear capabilities, led the apartheid regime to become increasingly cut off from sources of technology and international cooperation. Moreover, criticism in the form of mandatory sanctions and embargoes against South Africa soon followed because of Pretoria's continuous intransigence and refusal to join the NPT regime, and the overall apartheid policies. From the 1970s onwards, the issue of South Africa's nuclear capabilities was a constant feature on IAEA General Conference agendas. On an international scale, criticism and sanctions against South Africa accelerated, resulting in the country losing its seat on the Board of Governors of the Agency in 1976. The Board decided a year later (with 19 votes in favour,

<sup>88</sup> Newby-Fraser, 1979, pp. 20–25; see also Jaster, 1984, pp. 826–827.

<sup>89</sup> Internationally, the price of uranium had quintupled in the first half of the 1970s (Christie, 1984, p. 173).

12 against and Chile and Japan abstaining) that Egypt would take the seat as the ‘most advanced’ member state on the African continent. While the South African nuclear industry in practice far outmatched Egypt’s atomic sector, this move signalled a clear break with the IAEA’s earlier handling of the South African case. Western attempts for the IAEA Board to come to a traditional consensus decision sympathetic to South Africa and thus to prevent a vote going against the country had clearly failed.<sup>90</sup> Added to this downward spiral in mutual relations was the 1979 decision of the General Conference to reject South Africa’s credentials, denying it the right to attend. While Western European member states in tandem with the United States supported South Africa’s case, the developing countries and the Eastern bloc sided with Egypt.<sup>91</sup>

<sup>90</sup> Roehrlich, 2022, pp. 159–165.      <sup>91</sup> *Ibid.*, and Van Wyk, 2015, pp. 400–403.