

4 On the Fallacies of Cold War Nostalgia: Capitalism, Colonialism, and South African Nuclear Geographies

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As an old Cold Warrior, one of yesterday's speeches almost filled me with nostalgia for a less complex time. Almost.

—US Secretary of Defense Robert Gates, responding to Russian President Vladimir Putin's criticism of US foreign policy, February 2007

A peculiar nostalgia for the Cold War has pervaded American public discourse since September 11, 2001. Pundits and scholars alike invoke the Cold War as a time of clear, stark choices: capitalism vs. communism, good vs. evil, us vs. them. The oddly wistful tone of this false memory flows from the fiction that the Cold War remained cold, by which people usually mean that nuclear deterrence “worked”: against all odds, the United States and the Soviet Union didn't annihilate the human race. Such nostalgia relegates proxy wars to near-irrelevance, not only because of the subalternity of their locations and victims, but also because no atomic bombs exploded on their battlefields (despite a few close calls). The implicit contrast is with the complexity of present-day geopolitics, especially the threats posed by non-state actors and their entanglements with “rogue” nuclear states.

In history and memory, the superpower arms race remains the identifying mark of Cold War technopolitics. The arms race raised the stakes of ideological struggle to the level of apocalypse, and perpetuated simplifications. Countries were either “nuclear states” or not. Bombs were either atomic or conventional, materials either radioactive or not. The ontology of the “nuclear” seemed beyond political dispute, apparently derived from the esoteric realm of physics and the technological achievements of brilliant engineers. Cold Warriors and their activist opponents might clash about the nature of the communist threat, but they agreed that nuclear systems formed the quintessential, exceptional terrain on which to wage (or oppose) the Cold War.

The Cold War filter made nuclear things appear primarily an affair of the North and of nation-states. Nuclear weapons would replace colonialism as

a structure for situating nation-states in a global hierarchy. France and Britain saw them as technopolitical solutions to crises of national identity and security thrown up by their dwindling empires and the rising superpowers. Other nations later invoked nuclear systems (military, civilian, or mixed) as symbolic of their status as sovereign states. Nuclear systems became proof of post-colonial nationhood and offered solutions to newly configured problems of national and regional security. National nuclear expertise promised freedom from imperial dominance. International atomic organizations and treaties further codified nuclear nationalisms by differentiating “nuclear states” from all others.

In the first section of this essay I argue that multiple meanings and manifestations of the “nuclear” were produced and contested in the institutional accommodations of global Cold War. Nuclear ontologies—categories of things that did or did not count as “nuclear”—were ambiguous, not fixed. These ambiguities, I suggest, emerged from a set of dialectical tensions that played out in entities such as the International Energy Agency (IAEA) and the Nuclear Non-Proliferation Treaty (NPT): tensions between the geopolitics of colonialism and decolonization and those of Cold War East–West struggles, between managing the spread of nuclear weapons and encouraging the flow of other nuclear things, and between the moral high ground claimed by the prevention of planetary annihilation and the more mundane commercialization of nuclear power.

In its dual position as the West’s most notorious colonial power (after 1960) and one of its primary uranium suppliers (and the two were linked), apartheid South Africa played a pivotal role in these tensions, and in managing the resulting ontological ambiguities. In the second section, I explore how South African uranium enacted the neocolonial accommodations and nuclear ambiguities embodied in the IAEA and the NPT. Producing and selling South African uranium involved continually negotiating relationships among colonialism (especially its manifestation as apartheid), nuclearity, Cold War, and markets. These negotiations played out in—and between—global, national, and transnational spaces. The resulting technopolitics shaped global nuclear (dis)order in ways that have lasted well beyond the Cold War. My conclusion takes up some of these legacies.

Colonialism and Capitalism in the Making of Global Nuclearity

In 1951, atomic bombs and colonial power induced twin anxieties in leaders of the dwindling empires of Britain and France. That year, Churchill’s chief scientific advisor, Lord Cherwell, remarked: “If we have to rely entirely

on the United States army for this vital weapon, we shall sink to the rank of a second-class nation, only permitted to supply auxiliary troops, like the native levies who were allowed small arms but no artillery." French parliamentary deputy Félix Gaillard echoed the sentiment: "Those nations which [do] not follow a clear path of atomic development [will] be, 25 years hence, as backward relative to the nuclear nations of that time as the primitive peoples of Africa [are] to the industrialized nations of today." Nuclear = colonizer. Non-nuclear = colonized.¹

In 1951, nuclearity was still almost entirely about weapons: who had them, who could get them, how to use them, how not to use them. In 1953, Eisenhower's "Atoms for Peace" speech signaled the possibility of another state of nuclearity: atomic power plants. At one level, its rhetoric recycled the winged gospel into the atomic creed, whose first verse was world peace and boundless abundance thanks to an energy free-for-all. At another level, as John Krige has argued, "Atoms for Peace" was a panoptic Orwellian fantasy, doublespeak for "Atoms for War."²

As "Atoms for Peace" morphed into the International Atomic Energy Agency, the atomic creed left space for post-colonial leaders to challenge the technopolitical geography of nuclearity asserted by the West. India stepped in first. Nehru proclaimed nuclear development a fundamental building block of Indian national identity. During negotiations over the IAEA statute, Indian delegates raised a challenge. If representation on the IAEA's Board of Governors relied solely on technical achievement and a Cold War East/West balance, they charged, the agency would reproduce immoral global imbalances. Instead, qualification for Board membership should combine nuclear "advancement" with regional distribution.

The challenge worked. A complex formula allocated five permanent seats on the IAEA's Board of Governors to member states deemed globally "most advanced in the technology of atomic energy *including the production of source materials*," and another five according to geographical region.³ The remaining seats were distributed on a rotating basis to uranium producers in the Eastern and Western blocs, "suppliers of technical assistance," and global regional representatives at large. The result tempered Cold War obsessions with technological rankings with an acknowledgment of the geopolitical importance of decolonization, and laid an ideological and structural foundation for a global nuclear order.

But meaning and practice never flow directly from ideology and structure. What made a nation count as "most advanced"? What were "source materials," and how significant a manifestation of nuclearity were they? For decades, the meanings of these phrases were negotiated and renegotiated

in ways that reflected not only changing technologies, but also shifts in global Cold War geographies wrought by colonialism, decolonization, and nationalism.

Apartheid South Africa played a critical role in such negotiations early on. Its delegates to the IAEA statute talks, for example, had insisted on including “source materials” as an indicator of nuclear technological “advancement” in the agency’s statute. South African contracts to provide the United States and Britain with uranium ore for their atomic weapons had made the production of that particular “source material” vital to South Africa’s economy.⁴ Anticipating that the IAEA would play a central role in shaping uranium markets, and knowing that its apartheid policies would impede its election to the Board, South Africa desperately sought a permanent statutory seat. The apartheid state represented the antithesis of the postcolonial settlement pursued by India, which wanted to demote South Africa to one of the rotating “producer” seats. At the time, South Africa’s “nuclear” activities consisted only of uranium ore production underwritten by a very small research program. Prevailing on their British and American customers for support, however, South African delegates persuaded the others that “source materials” should count as an indicator of “advancement.” In a technopolitical geography where the Cold War trumped racial inequality and other African producers remained under colonial control, South Africa’s uranium production could serve as the pinnacle of *African* nuclearity.⁵

The question of whether “source materials” were sufficiently “nuclear” to warrant a governing seat on the IAEA begged the question of how to define “source materials” in the first place. Uranium ore had to undergo milling, refinement into yellowcake, conversion to tetrafluoride and/or hexafluoride, and enrichment before it could become fuel for nuclear reactors (or bombs). At exactly what point did uranium stop being “source material” and become “fissionable material”? The difference mattered enormously, because the two categories would be subject to different controls. In the words of one South African scientist, “the definitions would have to be essentially practical, rather than ‘textbook’ in nature, . . . legally watertight, and must take account of certain political implications.” In the end, the IAEA abandoned the more ambiguous term “fissionable material” (preferred by Indian delegates) in favor of three other categories: “source materials,” “special fissionable materials,” and “uranium enriched in the isotope 235 or 233.”⁶

These three categories—and the distinctions between them—mattered for safeguarding the nuclear order. How to control the flow of materials and technologies to ensure that instruments of planetary destruction didn’t fall

into the wrong hands? Who could be trusted with which systems? Which materials, knowledges, and systems were specifically nuclear? Exactly what would “safeguards” mean? Definitions alone didn’t prescribe a control method.

Such questions had to be worked out in conjunction with the *raison d’être* of the IAEA, and on this score the West and the Rest were split. Rhetorically, everyone agreed that promoting the “peaceful uses of atomic energy” was the IAEA’s central mission, one which endowed the agency with high moral purpose. But in practice, uranium producers and nuclear system builders had more mundane interests in mind: build reactors, make nuclear power commercially viable, and create a market for technologies and uranium that would sustain their own nuclear industries.⁷ The West would sell to the Rest, while somehow (the details remained fuzzy) ensuring that ensuing programs would serve civilian rather than military ends. By providing a bigger market, the Rest would help the West commercialize its nuclear power systems. Spearheaded by South Africa’s delegate, Donald Sole, representatives of the West argued that the IAEA should channel resources to countries that could develop nuclear infrastructures quickly, rather than function as yet another technical aid agency. But the Rest—led by India—saw things differently. The IAEA should ensure that emerging nuclear hierarchies not perpetuate global inequalities. They concurred that the agency should spread nuclear systems, but (for equally self-interested reasons) they argued for a broader distribution of resources.⁸

Also contentious were the conditions that would accompany whatever distribution of resources occurred. The United States wanted purchasers of nuclear technologies and materials to agree not to use their purchases toward military ends, and to accept international inspections in the name of averting apocalypse. Most other nations selling nuclear systems paid lip service to such measures. But buyers were underwhelmed by the prospect of controls, arguing (with India) that regulating access would perpetuate colonial inequalities and undermine national sovereignty.

Such high moral rhetoric obscured more mundane political and commercial issues. The US, the UK, and the USSR refused to accept inspections of their nuclear installations. Western European nations charged that IAEA safeguards inspectors could double as commercial spies, and accused the US and the UK of seeking competitive advantage. But it was their invocation of Cold War tensions (namely, that there could be no question of allowing Eastern Bloc IAEA inspectors into Western European nuclear facilities) that led to a 1961 agreement with the recently created Euratom, which granted its member states (France, Germany, Italy, and the Benelux countries)

the right to inspect each other's facilities.⁹ Third World nations with nuclear aspirations saw this Cold War-justified self-regulation as rewarmed imperialism.¹⁰

The Treaty on the Non-Proliferation of Nuclear Weapons (informally "the NPT"), meanwhile, expressed all the same tensions. Under the NPT, "nuclear weapons states" pledged not to transfer atomic weapons or explosive devices to "non-nuclear weapons states." The latter, in turn, renounced atomic weapons and agreed to accept IAEA safeguards and compliance measures. Strikingly, the NPT invoked human rights language and the rhetoric of development:

1. Nothing in this Treaty shall be interpreted as affecting the *inalienable right* of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes. . . .

2. All the Parties to the Treaty undertake to facilitate, and *have the right to participate in*, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also cooperate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, *with due consideration for the needs of the developing areas of the world.*¹¹

In an effort to accommodate post-colonial morality into a Cold War paradigm, the NPT essentially declared that nuclearity—of the "peaceful" persuasion—was a fundamental right. It thus codified nuclear exceptionalism: no other international agreements referred to any scientific or technological activity as an "*inalienable right*" of special importance to "the developing areas of the world."¹²

The NPT made nuclearity a global "right," but left matters of safeguards and "technical assistance" to developing nations to the IAEA. Between 1961 and 1972, the IAEA produced five documents, each with a somewhat different solution to the ontological problem of which materials and technologies were sufficiently nuclear to demand safeguards and inspections. By then South Africa had cemented the technological justification for its Board seat with an extensive nuclear R&D program, and wanted to minimize external oversight of its uranium industry. It led other uranium producers in continually, and successfully, pushing to exclude mines and ore-processing plants from official definitions. The 1968 safeguards document, for example, defined a "principal nuclear facility" as "a reactor, a plant for processing nuclear material, irradiated in a reactor, a plant for separating the

isotopes of a nuclear material, a plant for processing or fabricating nuclear material (*excepting a mine or ore-processing plant*). . . ."¹³ Uranium mines and mills were thus specifically excluded from the "nuclear"—even from the residual category of "other types" of "principal nuclear facilities." In 1972, uranium ore was specifically excluded, as well, from the category of nuclear "source material."¹⁴ NPT signatories did have to inform the IAEA of yellowcake exports, but these were not subject to international tracking or inspections. Nor were uranium mines and mills. Restrictions on the end use of uranium ore were relegated to bilateral agreements or sales contracts; they thus depended on the two parties involved, and consisted only of unenforced, unverified pledges on the part of the recipient.

Together, the IAEA and the NPT thus enacted the technopolitics of global Cold War. Ideologically, they appealed to the highest possible moral purpose: the safekeeping of the human race and its planet. At the same time, they offered the possibility of reconciling this danger with the (also morally powerful) promise of unlimited modernity. They thus produced the "nuclear" as a mutual, but structurally unequal, engagement of the Cold War with the colonial and the postcolonial.

They also served as a forum to work out another dimension of the global Cold War, at least from the perspective of the West. It wasn't enough to keep the world safe from annihilation: the world also had to be made safe for capitalist markets. Nuclear things couldn't merely be instruments of state—they also needed to be instruments of capital. With the right rules in place (i.e., ones that favored nuclear suppliers), the IAEA could function as a rather effective trade organization. And no nation was more enthusiastic about this dimension of the agency than apartheid South Africa, struggling to hang on to its colonial state within an international order that increasingly condemned its practices.

Uranium Markets for Apartheid

In 1954, when negotiations over crafting the IAEA first began, the United States and Britain had active contracts for large quantities of South African uranium. In South Africa, the ruling National Party had begun elaborating the complex bureaucratic and spatial apparatus of apartheid. In the rest of the world decolonization had barely begun, and South Africa wasn't quite the international pariah that it would soon become.

In the late 1950s, things began to change. The US Atomic Energy Commission decided it had ordered enough uranium, and announced that it

would stop buying foreign ore. "Stretch-out" agreements softened the economic blow to suppliers. These would expire in 1967, however, so South Africa had to find new customers if it wanted to keep that part of its industry going. This became increasingly challenging after 1960, which in South Africa marked the Sharpeville massacre and the country's withdrawal from the Commonwealth, and in the rest of the continent saw the formation of more than a dozen new postcolonial states.

As these newly independent states began entering the IAEA, they joined a push to evict South Africa. In 1963, some twenty nations signed a statement condemning the apartheid government and urging the IAEA to conduct "a review of South Africa's policy in the context of the work of the Agency."¹⁵ Donald Sole, South Africa's representative on the agency's governing board, denounced the declaration as "purely political" and insisted that the IAEA was "not a proper forum" for such matters. With support from the US delegation and a few others, he prevented the motion from passing.¹⁶ Clearly, however, South Africa would have to battle for a legitimate place near the top of the global nuclear hierarchy. Sole predicted that "the Afro-Asian upsurge, combined with the continued preoccupation with politics, will bring South Africa very much under the harrow." He kept pushing the IAEA to remain narrowly nuclear, not "just one more international organization for the provision of technical assistance which provides at the same time a platform for the propagation of varying ideologies, Western, Communist, Neutralist, anti-White, anti-colonialist and the rest."¹⁷

When he wasn't occupied with IAEA politics, Sole used the personal contacts he'd made at the agency to forge relationships with potential uranium customers. In 1959, he escorted two representatives of the South African Atomic Energy Board (AEB) all over Western Europe. This "sales survey team" sought to forecast supply and demand for the upcoming decade, guess at the probable price structure of commercial contracts, and assess how safeguards might constrain the sale of uranium.¹⁸ The tour proved so fruitful that the AEB's sales committee repeated it regularly, expanding it to include Japan's burgeoning nuclear power program. Increasingly, these trips involved marketing South Africa at least as much as uranium. In the inimitably oblique prose generated by apartheid state bureaucrats, the 1961 mission cheerfully reported that it "had been very well received and in a number of cases it was able to correct glaring misconceptions which existed overseas where South Africa was concerned."¹⁹

Nevertheless, marketing South African uranium remained tricky. In 1962, the United Kingdom signed contracts to buy 12,000 tons of uranium

from Canada. South Africans worried that this deal had been sealed by their nation's worsening international status—especially its recent withdrawal from the Commonwealth.²⁰ But they felt optimistic that the next two biggest consumers of uranium in the Cold War West, France and Japan, might care more about obtaining uranium free from bilateral safeguards—France because of its nuclear weapons program, Japan for reasons of national sovereignty.²¹ Eliminating safeguards clauses from contracts—which in any event had appeared only in response to US and UK pressure—could significantly expand South Africa's markets.²² The prospect of unrestricted uranium could trump squeamishness over apartheid. Furthermore, France was not just a potential customer for unsafeguarded uranium, but also a competitor. In the early 1960s, the French Commissariat à l'Énergie Atomique operated uranium mines in France, Gabon, and Madagascar, and had active prospects for large mines in Niger.²³ The French were interested in South African uranium to ensure continuity and diversity of supply, and also to free up some of their own reserves for sale. Contracts free of safeguards had clearly made French uranium attractive: South Africans suspected that Israel had “broke[n] off negotiations for supplies of Rand concentrates” because it had “instead obtained the supplies [it] required from France, without safeguard inspection requirements.”²⁴

In tackling the problem of how to sell more uranium abroad, South Africans at home found themselves arguing about the relationship between uranium's status as a nuclear thing, its status as a commodity, and the effect of apartheid on its marketability. These debates played out in institutional tensions between the Atomic Energy Board and the mining industry (represented by the Chamber of Mines).

Until 1961, South African uranium sales had remained under the sole control of the AEB, the state's guardian of things nuclear. But the AEB didn't produce uranium oxide directly—that was done by the mining industry, which treated uranium as a by-product of gold. So long as the American and British bomb programs were the only consumers of South African uranium, this arrangement had worked well enough. But with the end of those contracts, the mining industry wanted to take charge of marketing. In 1961 the Chamber of Mines appointed Hugh Husted as its own “uranium adviser,” and the Chamber and the AEB began discussing how to erect a uranium sales organization.²⁵

Husted's very first report challenged the AEB's long-standing policy of keeping nuclear things secret. He suggested publishing more detailed information about South African uranium production for the benefit of potential buyers.²⁶ South Africa's commercial consul in New York agreed, noting

that statistics “reflecting imports of Rand Concentrate” had already been published in the US and arguing that

it may also be opportune to review the arrangements in regard to the treatment of uranium oxide as an export commodity. At present information relating to uranium is treated as secret and is handled by the Department of Foreign Affairs, but there appears to be no reason why it should not in future be treated *as a normal export commodity*.²⁷

The mining industry and the Department of Commerce and Industry saw uranium as a commodity in search of customers. One might debate about whether uranium belonged in mineral markets or in fuel markets. Either way, however, publishing statistics could demonstrate South Africa's strength and reliability as a supplier to potential customers.²⁸ Effective capitalism, after all, relied on persuasion: that's what marketing was.

But the AEB and the Department of Foreign Affairs objected forcefully to publishing production statistics for South African uranium. The secrecy of all matters nuclear—which in South Africa still meant all matters uranium—could not be violated. Anxious to retain the final word on such matters, the AEB insisted that

uranium concentrates not be treated as a normal export commodity, because this material continues to have immense strategic significance and its transfer from one country to another is consequently fraught with political implications, also because countries like the United Kingdom and other possible buyers of South African uranium concentrates might not wish to have statistics published regarding sales of this material to them.²⁹

By suggesting that the preservation of secrecy might become a marketing tool, the AEB sought to preserve uranium's exceptionalism—and thereby its nuclearity, and the AEB's ultimate power to pronounce its fate.

AEB experts thus framed the importance of secrecy in nuclear terms. For some “possible buyers,” however, discretion was motivated at least as much by the provenance of the uranium. Consider France.

In 1963, Bertrand Goldschmidt, director of external relations for France's Commissariat à l'Énergie Atomique (CEA), traveled to South Africa to discuss possible uranium purchases and scientific exchanges. He wooed South Africans by conveying personal sympathy with their “race problem”:

M. Goldschmidt was most favourably impressed by South Africa and said that its economic strength and degree of development far surpassed his expectations. A few years previously he had spent some months in Kenya where his sister and her husband were now obliged to contemplate the abrupt loss of a large estate which they had

built up over the past 20 years; he was therefore well able to comprehend the point of view of the Europeans in Africa and the complex nature of our multi-racial problem.³⁰

Times were changing, however, and such matters now required tact.³¹ France needed to preserve a privileged relationship with its former colonies. For this it would gladly pay a premium. The CEA's contracts with Gabon, for example, "could not easily be reduced as they constituted an essential form of economic subsidy with political implications." None of France's uranium sources could match South African prices, "but the invisible cost to France of cutting down her own sources of production would have to be very carefully weighed in the balance."³² Precisely because uranium contracts always had implications beyond those of ordinary market transactions, Goldschmidt suggested, the CEA's willingness to purchase yellowcake depended on just how low the South African bid could go.

In the meantime, the CEA offered to help South African experts experiment with processes to convert their ore into uranium tetrafluoride. This offer of collaboration emphasized the benefits of thinking beyond mere market considerations. Goldschmidt's expressions of colonial solidarity, meanwhile, seduced the South Africans and gave them confidence that France, at least, would not let racial politics trump nuclearity. Hugh Husted argued that "the value of the deal in terms of money, while important, lies more in the long-term implications."³³ The French approach persuaded the South Africans to offer the CEA rock-bottom prices, and a substantial uranium contract resulted.³⁴

Before concluding the deal, however, Goldschmidt reiterated that France could in no way jeopardize its relationship with other African nations:

[T]here were international political considerations, notably the open objections of the Afro-Asian bloc to countries trading with South Africa. . . . [B]ecause of this latter implication, Mr Goldschmidt made it quite clear that any deal that might be concluded should be regarded as confidential.³⁵

Could anyone imagine a better vindication of the AEB's refusal to publish uranium production statistics? To be sure, the fact that France's motivation for secrecy stemmed from apartheid's threat to its postcolonial relations—not nuclearity—was a glitch. But this could be made to vanish easily enough. The AEB warned that the contract had to remain "strictly confidential, since the French authorities regarded all government contracts for nuclear materials as secret."³⁶ In a typical apartheid syllogism, secrecy was redistributed onto the nuclearity of uranium, the pesky matter of racism swallowed whole by Cold War reasoning.

Notwithstanding the AEB's rhetorical sleight of hand, the mining industry continued to fight for greater independence in uranium production. It achieved some measure of this in 1967 with the creation of the Nuclear Fuel Corporation (NUFCOR), structured as a consortium of uranium-producing gold mines. NUFCOR coordinated the uranium output of the mines, operated the plant that processed this output into uranium oxide, and marketed the oxide overseas. The arrangement gave the mining industry greater commercial autonomy while (in principle) preserving close technical collaboration with the AEB.

At first, relations between NUFCOR and the AEB went smoothly enough, thanks in no small part to the French connection. When the CEA's test conversion of South African ore to uranium tetrafluoride (UF_4) proved successful, NUFCOR placed an order for a French UF_4 plant. This pleased the AEB, which promptly suggested that NUFCOR now investigate the next stage of the industrial process: converting UF_4 into uranium hexafluoride (UF_6), the feed material for enrichment plants.³⁷

Some South African contracts specified uranium oxide, in which case the customer arranged conversion of the South African material separately, but some were for UF_6 . To satisfy these, NUFCOR had arranged for toll conversion at a British facility. But what if the new Labor government in Britain decided to block South African material? France had proved friendly to South Africa, and the French conversion process carried considerable commercial promise. Perhaps NUFCOR should switch to the CEA once its contract with Britain expired? Or even build a hexafluoride conversion plant in South Africa?

AEB metallurgists seemed utterly persuaded that selling a more highly processed product would inevitably yield greater profits. Raw materials, they argued, were what colonized, backward nations produced. A highly developed metallurgical industry placed South Africa ahead of the rest of the continent, assimilated it into the industrialized West. The nation practically had a duty to produce the most highly processed form of uranium. Besides, NUFCOR's profit margin would surely increase if it could sell UF_6 directly.

NUFCOR obviously found the prospect of a larger profit margin tempting. But it also knew that profits did not flow inevitably from processing. Conversion plants entailed high capital costs. Profits depended on economies of scale, trends in the price of uranium, finding enough willing customers, ore grade, efficient removal of impurities, the particular conversion process, and much more besides. So before committing to a UF_6 plant, NUFCOR commissioned a series of feasibility studies and market forecasts.³⁸

Meanwhile AEB officials squirmed impatiently. They had invoked the language of profit, but grander things were at stake. Sometime in the 1960s, the AEB had secretly begun research into a full-blown enrichment plant (hence its desire for conversion plants to produce the feed material).³⁹ Initial results seemed promising. This time, peeling off the first layer of secrecy governing nuclear activities might bolster South Africa's weakening international status—especially if framed in terms of the ideological edifice of nationalism, capitalism, and developmentalism with which the “Western powers” justified their nuclear hegemony. Prime Minister B. J. Vorster decided to go public with the fact (though not the details) of the enrichment project. In 1970 he revealed to Parliament the existence of a pilot plant, calling it an “obvious” step in the (white, industrial) history of the nation.⁴⁰ Enrichment would allow South Africa to market uranium more profitably, and eventually to supply its own nuclear power program. Vorster lauded South African scientists for bolstering “the prestige of their country. In the past they have made lasting contributions to science, but perhaps the achievement that I am announcing today is unequalled in the history of our country.” He went on:

The South African process, which is unique in its concept, is presently developed to the stage where it is estimated that under South African conditions, a large scale plant can be competitive with existing plants in the West. . . . South Africa does not intend to withhold the considerable advantages inherent in this development from the world community. We are therefore prepared to collaborate in the exploitation of this process with any non-communist country(ies) desiring to do so, but subject to the conclusion of an agreement safeguarding our interests. However, I must emphasize that our sole objective in the further development and application of the process would be to promote the peaceful application of nuclear energy—only then can it be to our benefit and that of mankind.⁴¹

Vorster's insistence on the “unique” character of the South African enrichment process would quickly pervade official discourse on this topic, serving as an affirmation of national(ist) technological prowess. So would the more veiled remark that a large-scale plant would prove competitive “under South African conditions.” That phrase encoded two things. First, the South African process was not really unique. It closely resembled the German “jet-nozzle” enrichment process. (Indeed, the ANC would later argue that South African experts had copied that process directly.⁴²) But high energy costs made the jet-nozzle process uneconomical in Europe. Hence the second bit of code: “South African conditions” referred to cheap energy, via cheap black labor. Official descriptions of the enrichment program elided these “conditions,” remaking them into an apolitical, technical trait of industrial development.

The prospect of commercial enrichment in South Africa also derived legitimacy from “existing plants in the West.” In 1970 the United States had a monopoly on the actual provision enrichment services, but pilot plants in France and the Netherlands heralded the arrival of a commercial enrichment market. South African efforts seemed in line with these, especially as apartheid leaders asserted that they would sign the NPT as soon as a few thorny matters of sovereignty were resolved.

In the event, South Africa didn't sign on to the NPT until 1991. We know today that Vorster didn't merely elide apartheid repression in this speech. Like most political leaders of nuclear weapons states, he also lied about the intent of the enrichment program. The lie was deeply entwined with an two-pronged assertion about South Africa's strong “non-communist” affiliation: South Africa would act like a responsible Western nation in matters both nuclear (by not proliferating) and capitalist (by sharing its technology under proper commercial conditions). A few days later, the Minister of Mines developed this theme by congratulating parliamentarians on “the insight shown . . . in not asking unnecessary questions”⁴³ about nuclear development over the years. This helped ensure the secrecy and security of atomic matters, which in turn bolstered South Africa's credibility as a responsible nuclear state. Maintaining secrecy not only proved the nation's nuclear modernity, it also helped South Africa weather geopolitical storms. In a typically oblique reference to international opposition to apartheid, one member asked:

What could it mean if the knowledge underlying this discovery [of a new enrichment process] became of more general knowledge throughout other countries of the world who are to-day looking with very suspicious eyes, shall I say, on South Africa? The security attached to this particular discovery to my mind transcends the need for security in any other matter at our disposal here in South Africa.⁴⁴

Secrecy thus legitimated South African nuclearity both inside and outside national borders.

For NUFCOR, the announcement of an enrichment program cast the AEB's push for a UF₆ plant in a new light. Clearly, the AEB needed a conversion plant to feed its enrichment plant. Feasibility studies showed that a hexafluoride plant would not be commercially viable below a minimum annual capacity of 4,000 tons of uranium.⁴⁵ Market forecasts suggested that demand would not support this capacity anytime soon. Yet there were other considerations: “As a financial proposition [the production of UF₆] might not be attractive to Industry but [it] might be considered as being in the national interest.”⁴⁶ So surely the state should subsidize the plant?

Whatever the case, NUFCOR refused to build a commercial-scale conversion plant on its own. The AEB and the mining industry compromised on a pilot plant, funded primarily by the state with a little help from NUFCOR's research budget.

As plans for South African enrichment capacity progressed, relations between the AEB and the mining industry deteriorated. The AEB's veil of secrecy thickened. NUFCOR received no information on the potential feed requirements for an enrichment plant. It began withholding information from the AEB, citing commercial confidentiality. AEB president A. J. A. Roux grew livid, noting acidly in mid 1974 that "in terms of the Atomic Energy Act the Board was entitled to ask that all information on uranium research should be disclosed to the Board." He hoped the situation wouldn't come to that.⁴⁷

The central objects of tension were the hexafluoride plant, the uranium market, and the relationship between them. Roux desperately wanted the hexafluoride plant so that South Africa could feed its own enrichment plant. It wasn't merely that the enrichment plant would in turn would fuel South Africa's atomic bombs (none of Roux's correspondence with the mining industry even hinted at this, and if NUFCOR directors suspected anything at this stage, they kept it out of their written records). Roux believed that the ability to produce enriched uranium—a product legitimated by Cold War capitalism, whose manufacture and flow powered neocolonial circuits—would protect South Africa's international standing:

The production of uranium in South Africa is a matter of great importance to the State, quite apart from the significant economic benefits that arise from the export of uranium concentrates. South Africa's position in international affairs and its prominent status as a foundation member of the International Atomic Energy Agency are very largely due to the fact that this country is one of the top three uranium producers in the world.⁴⁸

This position absolutely had to be preserved because the IAEA "was perhaps the last international body where South Africa was permitted to make a contribution and where South Africa's viewpoint was given respectful attention."⁴⁹ The solution to South Africa's political isolation lay in the uranium market. And there, Roux believed, prospects looked good: the spot price had begun to climb after an all-time low, and orders for reactors were up. "I am sure you will agree," Roux wrote to NUFCOR chairman A. W. S. Schumann, "that the present marketing situation indicates that a far greater quantity of uranium can be sold in future years than is currently being produced by the mining industry."⁵⁰

Schumann wasn't so sure. The spot price bore little relationship to real prices fixed in long-term contracts. Roux accused the mining industry of holding back crucial market forecasts. Schumann replied that "the whole subject of uranium marketing was very much more tentative than the Board might think and it was difficult to know how to give more information than was already supplied which could be useful." AEB director of extractive metallurgy R. E. Robinson chimed in: he needed NUFCOR's projections because he wanted to establish an econometric model to predict the uranium market. Surely, Schumann replied testily, this was beyond the scope of a metallurgical laboratory. On the contrary, Robinson affirmed, such knowledge was "essential . . . in formulating [a] research programme."⁵¹

As for Roux, he thought that "a projection of future uranium prices and their possible effect on the Industry's uranium production capability" was crucial to the decision about whether to build a commercial-scale enrichment plant. As documents, market forecasts could help to create the markets themselves. Could industry ramp up to this level of production? If so, would it? Schumann replied that "since the Industry had no official information on the prospects of for uranium enrichment in South Africa its interest in possible UF₆ production had declined."⁵² Without feed contracts—or, at the very least, more information about enrichment—industry had no incentive to increase production.

In the end, South Africa's conversion and enrichment plants did not help South Africa maintain its foothold in the IAEA. The apartheid state was voted out of the agency's Board of Governors in 1977. But its uranium flowed north long after the establishment of sanctions, and well after the emergence of concrete evidence of a bomb program. The apartheid state never did build a commercial-scale enrichment plant. But the facility that had begun its life as a pilot plant went on to enrich enough fuel for at least six atomic bombs. It was decommissioned, along with the bombs, during the death throes of apartheid—which were also the dying days of the Cold War.

Conclusion

Since the advent of democracy in 1994, South Africa has become the poster child for non-proliferation. Proliferation experts invoke the dismantling of South African bombs as evidence that atomic weapons development can be rolled back. The eradication of archival records by state officials is even, sometimes, presented as a virtuous act: destroying thousands of papers documenting apartheid's arsenal prevented atomic secrets from falling

into “unreliable” hands. Not, many would hasten to add, that the African Nation Congress itself posed a threat. But it had, after all, received support from countries like Libya during the liberation struggle. Who knew how former freedom fighters might repay such debts?

Such rhetoric renders nuclear renunciation as redemption, the eradication of history as an act of global citizenship. The moral of the story? If South Africa could give up the bomb, so can others.

But if we look beyond “the bomb,” if we push past the despair that scholars feel when facing large-scale archival annihilation, we can see that the history of South African uranium production carries deeper and more complex implications for the nuclear world we inherited from the global Cold War.

South African uranium networks involved wide-ranging accommodations between the Cold War, colonial power, and capital flows. American and British atomic arsenals in the early Cold War gave birth to large-scale uranium production in South Africa. The global commercialization of nuclear power enabled and structured by the IAEA, Euratom, the NPT, and other supranational institutions sustained such production. The South African uranium industry operated in a space delineated by entanglements between the politics of market capitalism and those of global Cold War. Representatives of the apartheid state helped to shape that space through their interventions in uranium’s nuclearity. France’s uranium purchase, for example, was driven by its own atomic arsenal, structured by Euratom’s safeguards, inflected by its ties to postcolonial Africa, and subsidized by its search for conversion business.

Cold War nostalgia trades on the notion that even though nuclear relations “back then” posed the prospect of planetary annihilation, bipolarity made their control relatively straightforward; the proof is that we’re all still around to talk about it. But the messiness of nuclear diplomacy today flows directly from Cold War structures and practices. Safeguards regimes and the uranium market emerged from the same historical processes. Uranium became a legitimate commercial product thanks to safeguards; the definitions and practices that constituted safeguards were circumscribed by the push to make uranium into a commodity. Thus South Africa could credibly claim to pursue commercial enrichment because the NPT and the IAEA defined a series of frameworks under which enriched uranium was a legitimate commercial commodity. The more other nations built on these frameworks, the more enrichment—and earlier stages of uranium production—became market activities. And the more the United States tried to dominate those markets, the larger and more unwieldy they became. Over

the course of the 1970s and the 1980s, the US implemented a series of measures designed to protect its domestic uranium production from foreign competition. In the long run, these only generated more competition, as producers elsewhere found niches for non-US uranium. From the perspective of “pure” market capitalism, the geographic spread of uranium production became more and more justified.

Safeguards measures did seek to keep pace with this expansion. In 1971, shortly after the NPT came into force, an international committee was formed to devise a “trigger list”—a list of things nuclear enough to trigger safeguards.⁵³ At that time, safeguards were understood as export controls: states in a position to export these things should somehow ensure that purchasers not divert them for military purposes. The first trigger list, published by the IAEA in 1974, was both brief and general. Even still, not all “nuclear exporters” agreed with its specifications. Competing lists developed, grew longer, became more detailed.⁵⁴ By the late 1990s, the list of enrichment plant components supposed to trigger safeguards exceeded 20 pages and specified the tolerances and diameters of shut-off valves and rotary shaft seals “especially designed or prepared” to handle uranium hexafluoride gas.⁵⁵ Yet not even these minute details resolved everything. Did uranium ore count as a source material? It depended which IAEA document you read. Did yellowcake count as “natural uranium” for export purposes? Also unclear. Until the passage of yet another protocol in 1997, uranium mines and mills were not subject to the ritual practices that certified the separation between civilian and military domains and established the relative nuclearity of things. (Even then, adherence to the protocol was voluntary.)

The end of the Cold War did not interrupt these dynamics between safeguards and uranium markets. If anything, it intensified them. Most immediately, the collapse of the Soviet Union enabled uranium producers in the former republics to sell their product to Western utilities at rock-bottom prices. Western uranium producers cried foul and lobbied for protectionist measures. Uranium producers in southern Africa (including Namibia) were especially distressed: they had just broken loose from the anti-apartheid sanctions that had hampered (though by no means stopped) their commercial activities in the mid 1980s, and had been looking forward to flooding the market.

The legitimacy of uranium as a commercial commodity has always had a geography. The end of the Cold War just made its contours more visible, and more extensive. It's not that the end of the Cold War changed nothing, but rather that the change has not been one from simplicity to complexity. Nor has it enacted a rupture. Current tensions between the

spread and containment of nuclear things have deep roots in the Cold War. They emerge directly from institutions, practices, and meanings generated during that time. At the dawn of the twenty-first century, Iranian leaders cite the “inalienable right” clause of the NPT to legitimate their nuclear efforts, arguing that any attempt to stop them would constitute imperialism. They use the discovery of large uranium deposits in Iran to argue for enrichment as the natural next step in their nation’s development. In its nationalism and its technopolitical logic, President Mahmoud Ahmadinejad’s announcement of Iran’s ability to enrich uranium eerily echoed Vorster’s declarations concerning South African enrichment.

In the 1970s and the 1980s, the prospect of an apartheid bomb was at least as frightening to postcolonial Africa as the prospect of an Iranian bomb is to twenty-first-century North America and Europe. The leaders of the African National Congress were not fooled by Vorster’s attempt to legitimate uranium enrichment in commercial terms. South African enrichment efforts were but the tip of the iceberg, they argued; the apartheid state was building a bomb. At the 1979 launch of the World Campaign against Military and Nuclear Collaboration with South Africa, director Abdul Minty led off UN hearings with a phrase that would resonate for years to come: South Africa was the “nuclear Frankenstein” of the West, and only through sanctions could the West redeem itself and hope to control its monster.⁵⁶ Sanctions were eventually imposed, but only after enormous resistance from the West, and not before the apartheid state built its bombs.

Some things are different. It matters that apartheid South Africa was deeply embedded in American and European nuclear networks, while post-revolution Iran is embedded in Russian networks and especially in black markets seeking to subvert dominant nuclear and uranium markets (we need to note that Iran under the Shah got its nuclear start from the United States and its uranium from southern Africa). In the case of Iran, it’s the West pushing for sanctions, the non-West resisting them. (Funny how these categories of Cold War geography continue to hold sway, even as their contents change.) Ahmadinejad has dismissed the power of sanctions with a wave of his hand, proclaiming them a thing of the past. (Debates still rage over whether economic sanctions against South Africa did anything to hasten the end of apartheid.)

Nevertheless, the pressures exerted by commodification remain strong. Russia resisted sanctions against Iran: it didn’t want to lose its multi-million dollar investment in the Bushehr reactor site, nor did it want to lose face by yielding to US pressure. The IAEA too has sought to protect its investments: it took Iran to task for not permitting inspections, but kept 55 projects of

“technical assistance” to Iran active until March 2007, when it suspended 22 of them (leaving the remaining 33 on the grounds that they had medical, agricultural, or humanitarian purposes).⁵⁷

As for the dream of postcolonial nuclearity, it's more powerful than ever. After the end of apartheid, South Africa regained its seat on the IAEA's Board of Governors. At a meeting in 2004, its representative to that august body vigorously defended Iran's right to enrich uranium, declaring that South Africa associated itself with the Non-Aligned Movement and citing a statement by President Thabo Mbeki:

The imposition of additional restrictive measures on some NPT States, while allowing others to have access to these capabilities, only serves to exacerbate existing inequalities . . . already inherent in the NPT and undermines one of the central bargains . . . contained in the Treaty.⁵⁸

The representative in question? None other than Abdul Minty, the very man who in earlier decades had led the charge against South African enrichment. Was it only because of concern about the intersections between nuclearity and imperial power that Minty defended Iran? Or do we need to bring the market back in for a fuller explanation? Because the ironies are endless. In March 2007, the ANC government declared that the time had come for South Africa to master the nuclear fuel cycle. Feasibility studies for commercial conversion and enrichment of uranium in South Africa are now underway. Again.

Acknowledgments

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Notes

1. Quoted on p. 41 of Cawte 1992 and p. 62 of Hecht 1998/2009.
2. Krige 2006.
3. Emphasis added. In 1956, members of the first category were the US, the USSR, the UK, France, and Canada; members of the second were South Africa, Brazil, Japan, India, and Australia. See Fischer 1997.

4. South Africa's uranium was located in the same mines that produced its gold. In the decade after World War II, supplying uranium to the US and Britain saved many of these mines from economic collapse and served as a conduit for massive foreign investment in South Africa's industrial infrastructure. See Borstelmann 1993 and Helmreich 1986.

5. "International Atomic Energy Agency," annex to South Africa minutes no. 79/2, 28/7/56, pp 10–11, National Archives of South Africa (hereafter NASA), BLO 349 ref. PS 17/109/3, volume 2. The position of South Africa relative to the IAEA is thoroughly documented in the BLO 349, BVV84, and BPA 25 series of these archives.

6. Ibid.

7. Forland (1997) sketches out how commercial considerations shaped the ways various nations approached safeguards. She also discusses the differences between bilateral and international safeguards, and conflicts within the US Atomic Energy Commission over what safeguards should consist of and how they should be implemented.

8. For more details, see Hecht 2006a.

9. Forland 1997; Krige 2008.

10. Scheinman 1987; Abraham 1998, 2006, 2009; Perkovich 1999; Forland 1997.

11. Article IV of Treaty on the Non-Proliferation of Nuclear Weapons (signed at Washington, London, and Moscow July 1, 1968) (emphasis added). For the full text of the treaty, and the US State Department's triumphalist version of its history, see <http://www.state.gov/t/np/trty/16281.htm>.

12. Between 1958 and 1993, the IAEA gave out \$617.5 million in "technical assistance." The top ten recipients were Egypt, Brazil, Thailand, Indonesia, Peru, Pakistan, the Philippines, Bangladesh, South Korea, and Yugoslavia (Office of Technology Assessment 2005).

13. IAEA, INFCIRC/66/Rev.2, September 16, 1968.

14. IAEA, INFCIRC/153 (corrected), June 1972.

15. "Joint declaration by a group of Members in Africa and Asia regarding South Africa," general debate and report of the Board of Governors for 1962–63, agenda item 10, October 1, 1963, NASA, BVV84 13/1, volume 7 and annex.

16. "Statement by South Africa," general debate and report of the Board of Governors for 1962–63, agenda item 10, October 1, 1963, NASA, BVV84 13/1, volume 7 and annex.

17. "Report of the South African Delegation to the Fifth General Conference of the IAEA," October 12, 1961, p. 32, NASA, BVV84 13/1, volume 7 and annex.

18. Donald Sole, "Uranium Sales Survey: Interim Report on Continental Western Europe," June 8, 1959, NASA, HEN 2756 ref. 477/1/17.
19. AEB Sales Committee, minutes of 5th meeting, February 24, 1961, NASA, HEN 2756 ref. 477/1/17.
20. See H. McL. Husted, "Uranium Sales," report no. 7, November 8, 1963, NASA: HEN 2757 ref. 477/1/17/2; A. J. Oxley to Acting Secretary for Foreign Affairs, "UK/Canadian Agreement for the Supply of 12,000 tons of Uranium," August 1, 1962, NASA, BLO 40 ref. 64/237.
21. See Forland 1997 for a detailed discussion of Japan's push to dispense with bilateral safeguards agreements in favor of IAEA oversight.
22. And, as a reminder, consisted merely of pledges: there was never any question of verification by inspections.
23. Forland 1997, p. 11.
24. A. J. Brink to H. R. P. A. Kotzenberg, "Sale of Uranium by France," March 14, 1962, NASA, HEN 2756 ref. 477/1/17.
25. AEB Sales Committee, minutes of 5th meeting, February 24, 1961, NASA: HEN 2756 ref. 477/1/17; AEB Marketing Advisory Committee, minutes of 1st meeting, February 2, 1962, NASA: HEN 2756 ref. 477/1/17; H. McL. Husted, "Uranium Sales Organization, Report No. 1: 1962, Mission to Europe 15th October to 30th November, 1961," NASA: HEN 2757 ref. 477/1/17/2.
26. Husted, "Uranium Sales Organization."
27. Consul (Commercial) New York to Secretary for Commerce and Industry in Pretoria, November 30, 1962, included in AEB Marketing Advisory Committee, Supplementary Agenda for the 1st meeting for February 2, 1962, NASA: HEN 2756 ref. 477/1/17 (emphasis added).
28. Ambassador (Brussels) to Secretary of Foreign Affairs, "Visit to Brussels of Mr. Husted," September 28, 1962, NASA: BLO ref. 64/237.
29. AEB Marketing Advisory Committee, minutes of 1st meeting, February 2, 1962, NASA: HEN 2756 ref. 477/1/17 (originally all in capitals).
30. J. R. Jordaan (Ambassador to Paris) to Secretary for Foreign Affairs (Pretoria), "Uranium Sales to France," May 9, 1963, NASA: BPA, volume 8, ref. 18/25 part 1.
31. Moments like this—when Europeans would find ways to express support for South African racial policies in order to continue doing business—abounded. Another example: In 1964 Euratom's Belgian director-general, F. Spaak, traveled to South Africa in order to assess the sophistication of its industrial economy and discuss a possible uranium supply chain. Spaak's report did admit that black mine workers were paid one-fiftieth as much as whites, but his explanation mimicked that

of the Transvaal Chamber of Mines: "Wage levels have been and still are strongly attractive to Africans when the normal conditions of existence of the Africans in Central and South Africa are considered." (Was Spaak thinking of Belgian colonial mining companies as he wrote?) The sheer magnitude of the mining industry impressed him with its stability, power, and ability to shield South African uranium from market vagaries. Spaak concluded that South Africa had "considerable elasticity in uranium production based on the peculiar mining conditions applicable to the country." In the long term, he expected that South Africa would remain "an important supplier of limited quantities of uranium until the end of the century and perhaps until deep into the next century," and that Euratom should therefore maintain active contracts with South Africa. F. Spaak and J. Brinck, Report on South Africa and Its Uranium Supplies (A Translation from a German Version of a Report Originally Written in French), July 17, 1964, p. 4, 24, 30, NASA, MMY65 M3/7.

32. Ibid.; J. R. Jordaan (Ambassador to Paris) to Secretary for Foreign Affairs (Pretoria), "Uranium Sales to France," May 9, 1963, NASA: BPA, volume 8, ref. 18/25 part 1.

33. Husted, "Uranium Sales," p. 10.

34. The contract specified a firm delivery of 1,300 tons of uranium oxide between 1964 and 1968, an option to double the quantity during that period, and an option on another 1,000 tons between 1969 and 1973. AEB Marketing Advisory Committee, minutes of 6th meeting, March 23, 1964, p. 5, NASA: HEN 2757 ref. 477/1/17/2.

35. Ibid, p. 5.; Husted, "Uranium Sales," p. 10.

36. AEB Marketing Advisory Committee, minutes of 6th meeting, March 23, 1964, p. 5, NASA: HEN 2757 ref. 477/1/17/2.

37. NUFCOR, Record of discussions held in Johannesburg among representatives of SUCP, CEA, NIM, and NUFCOR on November 7, 8, and 12, 1968, Goldfields Archives (Rhodes University, Grahamstown, South Africa): records of the Nuclear Fuel Corporation (NUFCOR) Uranium Technical Advisory Committee (UTAC).

38. The material on these debates is too voluminous to cite individually. Records of meetings, economic and technical feasibility studies, and other correspondence relating to a potential UF₆ plant for NUFCOR can be found in the UTAC papers from 1968 to 1973 (Goldfields archives).

39. Some archival documentation concerning the enrichment project survives in the National Archives of South Africa; see, for example, papers in EAE 143 ref EA 2/2/13, volume 1 and MEM 1/590, ref. 121/2.

40. Newby-Fraser 1979, p. 91. This was the official history of the AEB, written by its public relations director; it's full of nationalist assertions of South African technological prowess.

41. "Verklank deur Sy Edele die Eerste Minister," 20 Julie 1970 (n.a.), NASA, MEM 1/590, ref. 121/2.
42. Cervenka and Rogers 1978; African National Congress 1975; Dan Smith, "South Africa's Nuclear Capability" (World Campaign against Military and Nuclear Collaboration with South Africa; UN Centre Against Apartheid, February 1980).
43. Republic of South Africa, Assembly Debates, July 27, 1970, p. 476.
44. Republic of South Africa, Assembly Debates, 27th July 1970, p. 475.
45. See, for example, J. C. Paynter and H. E. James, "Feasibility Study of the Commercial Production of Uranium Hexafluoride in South Africa," National Institute for Metallurgy Research report no. 924, March 16, 1970, Goldfields archives, UTAC papers.
46. NUFCOR, report of 18th meeting of UTAC, May 14, 1970, p. 4, Goldfields archives, UTAC papers.
47. R. E. Worroll, report on Interview with Dr. A. J. A. Roux in Pelindaba, June 17, 1974, part of NUFCOR/UTAC Circular no. 26/74, July 5, 1974, Goldfields archives, UTAC papers.
48. A. J. A. Roux to A. W. S. Schumann, liaison between AEB and NUFCOR, 3.6.74, part of NUFCOR/UTAC Circular no. 26/74, July 5, 1974, Goldfields archives, UTAC papers.
49. R. E. Worroll, report on Interview with Dr. A. J. A. Roux in Pelindaba, June 17, 1974, part of NUFCOR/UTAC Circular no. 26/74, July 5, 1974, Goldfields archives, UTAC papers.
50. A. J. A. Roux to A. W. S. Schumann, Liaison between AEB and NUFCOR, 3.6.74, part of NUFCOR/UTAC Circular no. 26/74, July 5, 1974, Goldfields archives, UTAC papers.
51. R. E. Worroll, report on Interview with Dr. A. J. A. Roux in Pelindaba, June 17, 1974, part of NUFCOR/UTAC Circular no. 26/74, July 5, 1974, Goldfields archives, UTAC papers.
52. R. E. Worroll, report on interview with Dr. A. J. A. Roux in Pelindaba, June 17, 1974, part of NUFCOR/UTAC Circular no. 26/74, July 5, 1974, Goldfields archives, UTAC papers.
53. This was called the Zangger committee, after its chairman, Claude Zangger. It was initially composed of 15 states that were "suppliers or potential suppliers of nuclear material and equipment." IAEA, INFCIRC/209/Rev. 1, Annex. See Hecht 2007 for more details.
54. Notably, two trigger lists developed in parallel: one under the rubric of INFCIRC/209, and another under the rubric of INFCIRC/254. Different nations

adhered to different lists; the two streams were brought into synch in 1977, but continue to develop separately.

55. IAEA, INFCIRC/209/Rev. 1/Mod. 4, April 26, 1999.

56. *Nuclear Collaboration with South Africa: Report of United Nations Seminar*, London, February 24–25, 1979. See also Smith 1980.

57. Molly Moore, "UN Nuclear Agency Curtails Technical Assistance to Iran," *Washington Post*, March 9, 2007.

58. South Africa Statement by Abdul Samad Minty, IAEA Board of Governors, Vienna, November 29, 2004, re: Item 4 (d): Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran: Report by the Director General (GOV/2004/83), available at www.dfa.gov.za.

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