

NUCLEAR MONITOR

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A PUBLICATION OF WORLD INFORMATION SERVICE ON ENERGY (WISE)
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Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor:

- We write about Brazil's faltering nuclear power program and a related bribery and kick-back corruption scandal.
- We look at another country where the nuclear power program has become embroiled in corruption: South Africa.
- Dave Sweeney writes about new Australian legislation which shields the uranium industry from potential litigation arising from uranium sales to India.
- Arnie Gundersen from Fairewinds Associates challenges some of the claims made by advocates of nuclear power as a response to climate change.

The Nuclear News section has reports on a referendum in Switzerland which rejected plans for a speedier phase-out of nuclear power; and progress developing large-scale cyclotron production of the most commonly-used medical isotope, technetium-99m.

Feel free to contact us if you have feedback on this issue of the Monitor, or if there are topics you would like to see covered in future issues.

Regards from the editorial team.

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Brazil's nuclear power program undone by corruption

Author: *Jim Green – Nuclear Monitor editor*

NM835.4604 The future of Brazil's partially-built Angra-3 reactor is uncertain in the wake of a wide-ranging corruption scandal that has engulfed the country. Angra-3 was conceived in controversy in 1975 and it may die in controversy.

The turnkey Angra-1 reactor was built by Westinghouse from 1971 to 1982. Angra-1 suffered continuing problems with its steam supply system and its load factor was only 25% over its first 15 years, but since 1999 it has performed "much better" according to the World Nuclear Association.¹

Then came the hugely controversial "deal of the century" between Germany and Brazil for the supply of eight reactors, a suite of nuclear fuel cycle facilities and oodles of technology transfer despite Brazil's obvious interest in nuclear weapons. Academic Matthew Bunn explains:²



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"In 1975, Brazil and Germany agreed on a nuclear "deal of the century" in which Germany was to provide several reactors and a complete nuclear fuel cycle, including both an enrichment plant and a reprocessing facility, under international safeguards. (The deal was later drastically scaled back, due to delays, economic constraints, and U.S. pressure.)

"At about the same time, Brazil launched a secret, unsafeguarded "parallel program" run by the military, divided into segments run by different services, with the Navy pursuing centrifuge enrichment (ultimately successfully establishing an enrichment facility), and the Army pursuing plutonium production.

"Personnel trained in the safeguarded program with Germany were transferred to the weapons program, and technologies from the safeguarded program are

believed to have been used in both the unsafeguarded enrichment facility and a small plutonium separation facility. The weapons program was cancelled under a later civilian government, and following the Brazil-Argentina rapprochement, all of Brazil's nuclear facilities are now under safeguards."

Under the Germany/Brazil agreement, the Angra 2 and 3 pressurized water reactors were to be built immediately, with equipment from Kraftwerk Union (KWU). Work began on Angra-2 in 1976 but was suspended due to a lack of finances and lower than expected growth in electricity demand. Work resumed in 1995 and the reactor came online in 2000. Three years earlier, Eletronuclear was formed as a subsidiary of state energy utility Eletrobrás and assumed responsibility for construction and operation of nuclear power plants.

Angra-3

The development of Angra-3 – a Siemens/KWU pressurized water reactor, identical to Angra-2 – began in 1984 but was halted in 1986 before full construction began. In 2006, the government announced plans to complete Angra-3 and also to build four more reactors beginning in 2015. In 2008, Eletronuclear signed an agreement with Areva for work on Angra-3. In mid-2010, the National Nuclear Energy Commission granted a construction licence and work began on Angra-3 after a 24-year hiatus. In November 2013, a contract was awarded to Areva in line with the 2008 agreement.

And then the Angra-3 project began to fall apart ... again. Funding was a problem. Areva said in April 2015 that progress on the project was "dependent on the securing of project financing by the customer".³ Areva announced in June 2015 that it had reduced its activities at Angra-3 due to delays in securing financing for the remainder of the project.^{4,5}

In August 2015, four Brazilian construction companies stopped work on Angra-3 due to non-payment of millions of dollars from Eletronuclear, and in the context of an escalating bribery corruption scandal engulfing the construction companies as well as Eletronuclear, Eletrobrás, politicians and political parties.^{6,7}

The following month, Eletrobrás suspended work on Angra-3 pending an internal corruption inquiry. Eletronuclear CEO Pedro José Diniz de Figueiredo – newly appointed after the July 2015 arrest of former CEO Othon Luiz Pinheiro da Silva in connection with the corruption scandal – said all building contracts for the project had been frozen for 90 days.⁸

Over a year later and the Angra-3 project remains frozen. Figueiredo said in April 2016 that several issues needed to be resolved: completion of the internal corruption investigation; setting a new budget for the project, cancelling contracts suspected of being fraudulent and conducting a new tender process, and renegotiating funding for the project.⁹

When construction began in 2010, commissioning of Angra-3 was expected in late 2015.¹ Now, Eletrobrás and Eletronuclear hope to commission the reactor in 2021.¹⁰ But that timeline assumes that work will resume, and that it will resume in 2017, and both assumptions are doubtful.

According to the World Nuclear Association, the timeline for completion of Angra-3 is "indefinite, maybe 2022"; in other words, it may never be completed.¹

Construction of Angra-3 is about two-thirds complete according to Eletronuclear.⁹ But more funding is required to complete the project. According to *powertechnology.com*, an additional US\$1.8 billion is required in addition to a government loan previously secured.¹¹ In December 2016, Eletronuclear executives will visit China in an attempt to secure new investors to complete Angra-3.¹² China might be interested in supporting Angra-3 if it opens up options for the deployment of Chinese reactor technology in Brazil (as with Chinese funding for Hinkley Point C in the UK). But it is doubtful whether new reactors will be built in Brazil in the foreseeable future.

Eletrobrás and its subsidiary Eletronuclear are in no position to be covering the funding shortfall for Angra-3. In November 2015, Eletrobrás booked a 3.39 billion reais (US\$980 million) impairment charge on Angra-3.¹³ In the same month, Eletrobrás announced that it would cut 13,000 jobs over the next two years, around 30% of the utility's staff.¹⁰

Then Eletrobrás reported its biggest ever annual loss: a net loss of 14.4 billion reais (US\$4.1 billion) in 2015. Economic consulting firm *BNamericas* reported that the largest write-down was 5 billion reais (US\$1.44 bn) for Angra-3.¹⁴

The estimated cost of Angra-3 has increased significantly. According to *BNamericas*, in the late 2000s the estimated cost was US\$5.4 billion whereas the latest estimate is 121% greater at US\$12 billion.¹⁵ According to the World Nuclear Association, the estimated cost in 2010 was US\$6 billion and it is now US\$7.6 billion.¹ Cost increases have arisen due to exchange rate fluctuations, inflation and additional works required to satisfy environmental concerns.¹⁵ Eletronuclear reportedly estimates additional losses of US\$1.7 million per day if the reactor is not operational by the end of 2018.⁷

Corruption and crisis

Angra-3 featured in the 'Most Controversial Projects 2015' list compiled by RepRisk, a business intelligence provider specializing in environmental, social, and governance risk analytics.¹⁶ Angra-3 was listed at number five in RepRisk's top 10. The award citation read:

"Repeated allegations of corruption have led to the inclusion of Brazil's third nuclear power plant, the Angra 3 Nuclear Reactor, in the MCP 2015 report. ... [I]n May 2015, Eletrobras found itself embroiled in a corruption scandal, when it was alleged that Edison Lobao, Brazil's former Minister for Mines and Energy, had received BRL 1 million (USD 250,000) to help the construction company, UTC Participacoes, win a contract for the Angra 3 Nuclear Plant.

"It was then revealed that the CEO of Eletronuclear had accepted bribes from construction companies involved in the Angra 3 project and in July 2015, he was arrested for allegedly receiving BRL 4.5 million (USD 1.1 million) in kickbacks between 2009 and 2014 from Andrade Gutierrez and Engevix Engenharia (Engevix). A senior energy executive of Andrade Gutierrez was also arrested. Investigators then began to probe the Angramon consortium, charged with constructing Angra 3 ...

“Later in July [2015], hundreds of shareholders of Eletrobras filed charges against the company in New York, claiming that the firm had known about the corruption at Eletronuclear and had hidden the fact for more than a year. One month later, Eletrobras and some of its executives were sued in a class-action lawsuit in a US District Court for violating the US Securities Exchange Act and for providing materially false statements related to the awarding of USD multibillion construction projects, including the Angra 3 Nuclear Reactor.

“In November 2015, the Brazilian Administrative Council for Economic Defense (CADE) launched an investigation into a group of construction companies, including UTC Engenharia, EBE, Construtora Andrade Gutierrez, Construtora Norberto Odebrecht, Construtora Queiroz Galvao, Camargo Correa, and Techint, on suspicions that they had formed a BRL 3 billion (USD 775.3 million) cartel to rig the bidding for the Angra 3 Nuclear Reactor. According to CADE, the cartel was known as the “big group,” which held meetings to agree on the prices and winners of each construction tender.

“In December 2015, Brazil’s Federal Criminal Court ratified the charges brought by the Federal Ministry of Public Prosecution against Eletronuclear and former executives of Andrade Gutierrez for corruption related to the Angra 3 Nuclear Reactor. The CEO of Eletronuclear, a shareholder of Engevix, and the former president of Andrade Gutierrez Energia were placed under house arrest.”

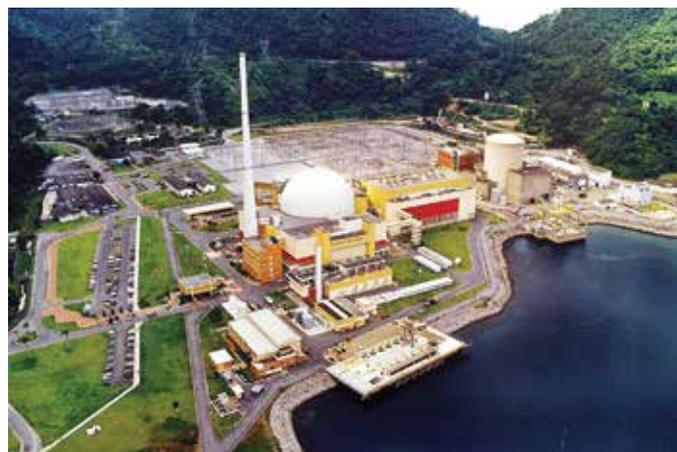
Eletronuclear CEO Othon Luiz Pinheiro da Silva, considered the father of Brazil’s nuclear program, was arrested in July 2015. In the same month, Luiz Pinguelli Rosa, a nuclear physicist and Eletrobras’ chief executive from 2003–2005, said: “The arrest is a tragedy for the industry. The industry was already in crisis, but now the corruption concerns are bound to delay Angra 3 further and cause costs to rise even more.”¹⁷

The drama has continued this year. In August 2016, Silva was sentenced to 43 years in prison for colluding with executives at Brazilian construction companies to set up an over-billing and kick-back operation for Angra-3.^{18,20} Investigators alleged Silva skimmed up to 30 million reais (US\$8.6 m) from Angra-3 engineering and construction contracts.¹⁹

The judge said in his ruling: “The elements of the court findings permit the conclusion that the corruption scheme was structured before, during and after the tenders for Eletronuclear’s construction of Angra 3 and consisted in the payment of bribes to public servants and agents” by the construction and engineering companies.¹⁸

In addition to Silva, 12 other people, including Silva’s daughter, were sentenced in August 2016 for their involvement in the embezzlement of public funds.²⁰

In July 2016, prosecutors announced that Eletronuclear CEO Pedro Figueredo had been suspended from his duties for allegedly colluding with Silva and interfering with the company’s internal investigations.¹⁹ In the same month, 19 people were arrested for allegedly paying bribes to senior executives of Eletronuclear.²² In return for bribes, Eletronuclear executives allegedly let construction companies inflate the cost of contracts



The Angra nuclear power plant, 100 km west of Rio de Janeiro

for Angra-3, and politicians and political parties were also beneficiaries of the corruption.²²

In May 2016, Brazil’s second biggest contractor, Andrade Gutierrez, agreed to a plea deal and will pay one billion reais (US\$288 million) to settle the matter. The company was involved in corrupt dealings in connection with Angra-3 and other projects.²¹

A future for nuclear power in Brazil?

Angra 1 and 2 provided Brazil with 13.9 terawatt-hours or 2.8% of its electricity in 2015, down from a maximum of 4.3% in 2001.²³

In addition to Angra 1–3, plans for an additional 4–8 reactors have been discussed. However, as the World Nuclear Association notes, “funding is likely to be a problem”.¹ Claudio Salles, president of Instituto Acende, a Brazilian energy-research group, said in mid-2015: “These [nuclear] plants take 10–15 years to build and as time goes on they become less viable.”¹⁷

Plans to expand renewable energy have better prospects. The World Nuclear Association states that power from existing nuclear plants at about US\$75/MWh is about 1.5 times more expensive than hydropower, and power from Angra-3 is expected to be slightly over twice as expensive as hydro.¹

Hydro generates about three-quarters of Brazil’s electricity. Plans are in train to add around 40 gigawatts (GW) of new hydro capacity by 2035, primarily from small- to medium-sized run-of-the-river plants which generally have a small impact on the environment and indigenous tribes when compared to some large hydro projects.²⁴

Brazil’s Ministry of Mines and Energy says that wind power will make up over 30% of new capacity in the next 11 years, and that at least 25 GW of new wind power capacity will be added by 2035.²⁴

Modest increases of solar and biomass (primarily leftovers from other production processes, such as bagasse from sugarcane processing) are planned. Brazil plans to shut down its coal-fired power plants (2.5 GW) by 2030, and no new permits for coal-fired plants will be granted.²⁴

In mid-2015, Brazil announced its intention to increase the share of non-hydro renewable electricity sources to 20% by 2030.²⁵

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Australia's dangerous uranium deal with India

Author: *Dave Sweeney – nuclear free campaigner with the Australian Conservation Foundation.*

NM835.4605 Late on the last night of the last sitting of Federal Parliament for 2017, Australia's two major parties passed a new law that is civil by name, but it is desperately uncivil in nature.

The Indian Civil Nuclear Transfers Act¹ exists to provide certainty to Australian uranium producers who want to sell to India. In 2015, a detailed investigation by the Federal Parliament's treaties committee found there were serious and unresolved nuclear safety, security and governance issues with the proposed sales plan.²

The treaties committee also found a high level of legal uncertainty. Australian National University professor of international law, Don Rothwell, said the plan was in conflict with international treaty provisions, most notably the South Pacific Nuclear Weapons Free Zone Treaty.³ Former Australian Safeguards and Non-proliferation Office Director-General, John Carlson, said the plan was in conflict with Australian domestic safeguards

legislation requiring the tracking of Australian uranium (and its by-products) overseas.

Given the severity of the inconsistencies and the significance of the issues involved, the government-controlled treaties committee took the unusual step of voting against the clear direction of the prime minister and foreign affairs minister and recommended that the Indian sales deal not be advanced unless several outstanding issues were addressed.⁵

This decision was welcomed by many. But not by Minister for Foreign Affairs Julie Bishop. A terse response to a measured and bipartisan report said the government was "satisfied" that steps had been taken to address each condition, and did not agree that exports to India should be deferred.⁶

The commercial interests of an underperforming industrial sector were given priority above parliamentary process and evidence-based, prudent public policy.



Photo from International Campaign to Abolish Nuclear Weapons.

But this favoritism was not enough to paper the deep cracks in this dangerous plan and now the government has rushed through the new laws to close the door on legal challenge and scrutiny.

The new law protects uranium mining companies in Australia from domestic legal action that challenges the consistency of the safeguards applied by the International Atomic Energy Agency in India and Australia's international non-proliferation obligations. It also protects any future bilateral trade in other nuclear-related material or items for civil use.

A recent truncated review of the new law said the bill "provides the certainty required to give effect to the Australia-India Agreement".⁷ So Australian uranium miners, who supplied the product that directly fuelled Fukushima⁸, are now legally covered from any challenge over a highly contested plan to sell to India.

This move highlights the extent and the risks of the Australian government's preoccupation with ending civil society access to legal recourse. Further, fast-tracking legal favors to provide certainty to the uranium industry simply highlights how profoundly uncertain this industry is. Following Fukushima, the global uranium market has crashed, as has the value of uranium stocks. Prices, profits and employment numbers have gone south. IBIS World's March 2015 market report said only 987 people

are employed in Australia's uranium industry.⁹ Few jobs and dollars, considerable damage at home and escalating risk abroad.

The fragile economics of the uranium sector make it understandable that the industry is pushing for every potential market but fail to explain why our federal government is so intent on trying to pick winners with a sector that is clearly losing. Sadly, and unreasonably, the India uranium deal has become seen as a litmus test for bilateral relations.

Talk of a massive surge in exports is fanciful, and promoting Australian uranium as the answer to Indian energy poverty is more convenient than credible. Political proponents of the trade are driven less by substance than style – the symbolism of Australia and India on the same page and open for business.

In a telling reference, a recent review of the new law highlighted the importance of the "foreign policy backdrop to Australia's nuclear trade with India".¹⁰ Sending political signals through trade is not unusual but to do so by ignoring substantive warning signals is unwise. When those warnings and that trade relate to nuclear materials, it is deeply irresponsible.

Buttressing flawed trade deals with bolt-on legislative exemptions is poor policy and practice and while all trades have trade-offs, this one risks far too much.

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Nuclear power is not “green energy”

Author: Arnie Gundersen – chief engineer of Fairewinds Associates.

NM835.4606 Starting in 1971, I became a card-carrying member of the “nuclear priesthood.” I began as a licensed nuclear reactor operator and progressed through the industry to become a senior vice president. I believed, with religious fervor, that by helping to build and operate atomic power reactors, I would be creating power that was “too cheap to meter.” The historic 1973 gasoline shortages and long lines of cars queued at the pumps made it clear to me and hundreds of other nuclear engineers that nuclear power was the only solution to the “energy shortage.” In the 1970s and ‘80s, solving this apparent energy shortage was our only mantra. At that time, there was no scientific data connecting fossil fuels to climate change.

In 1953, President Eisenhower initiated his “Atoms for Peace” program as a means to transform the atom from a scourge into a benefit for mankind and created grand illusions of at least 1,000 US atomic plants by the year 2005. However, well before the 1979 disaster at Three Mile Island, nuclear construction costs were skyrocketing and construction schedules were constantly slipping. The overzealous goal of 1,000 US atomic power reactors dwindled to about 110 finally completed reactors, while more than 120 others that had been on the drawing boards were canceled before producing a single watt of power.¹

By 1985, Eisenhower’s dream of reclaiming the power of the atom for peaceful purposes had unraveled and had become a nightmare. Electric rates continued to skyrocket² and ratepayers were left picking up the pieces from Atoms for Peace.

Of the more than 230 attempts to construct atomic power reactors in the United States during the 20th century, only 99 reactors are still operating. Globally, a total of 438 atomic power reactors were still operating in 2015, according to the World Nuclear Association.

During the 20th century, the lights stayed on and the prediction of a dire energy shortage never materialized. Nuclear power’s claims that it would be an economic nirvana “too cheap to meter” collapsed as well. Entering the 21st century, renewables began to appear more feasible, so the atomic power industry latched on to NASA’s James Hansen’s 1988 prognosis of the global buildup in CO₂ resulting in global climate change as a new justification for existence. Armed with this new marketing ploy, nuclear power lobbyists flooded Capitol Hill looking for financing to fund the 21st century “nuclear renaissance.”

Does the nuclear industry’s latest claim that it is the world’s salvation from increasing levels of CO₂ hold up under scrutiny? No. The evidence clearly shows that building new nuclear power plants will make global warming worse.

A growing carbon footprint

Before we look at the data, two concepts are important to clarify. First, burning a fossil fuel like coal or oil emits CO₂.³ The amount of CO₂ emitted into the atmosphere

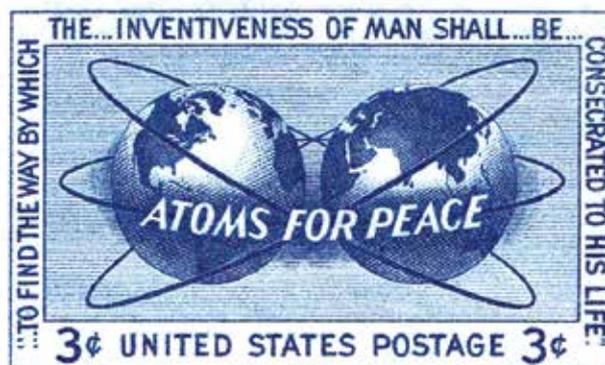
each year is massive, measured in gigatons. A single gigaton is one thousand million tons of CO₂ gas. The second concept is “ppm,” or parts per million. As all this CO₂ is dumped into the atmosphere, it is diluted by air. The concentration of CO₂ atoms in air is measured in parts (molecules) of CO₂ divided by one million air molecules, hence parts per million. In preindustrial times, normal background levels of global CO₂ levels were around 280 ppm.⁴

When the first large commercial nuclear power plant went on line, global emissions of CO₂ were about 16 gigatons in 1970 and the concentration of CO₂ in the air was about 320 ppm.⁵ Hansen and 350.org claim that the world’s CO₂ levels must stay below 350 ppm to avoid catastrophic climate change, a level that was exceeded late in the 1980s.⁶ By 2015, well after more than 438 heavily subsidized atomic power plants were constructed worldwide, global emissions from burning fossil fuels have reached 36 gigatons. The CO₂ concentration in the atmosphere has already exceeded 400 ppm and is increasing by about 2 ppm yearly.

Nuclear power lobbyists and their marketing firms want us to believe that humankind’s current CO₂ atmospheric releases would have been much worse were it not for those 438 power plants now operating. How much worse? The World Nuclear Association industry trade group estimates that an additional 1.1 gigatons of CO₂ would have been created in 2015 if natural gas plants supplied the electricity instead of those 438 nukes.⁷ Worldwide, all those nuclear power plants made only a 3 percent dent in yearly CO₂ production. Put another way, each of the 438 individual nuclear plants contribute less than seven thousandths of one percent to CO₂ reduction. That’s hardly enough to justify claims that keeping your old local power plant running is necessary to prevent the sea from rising.

Let’s fast forward to 2050. Massachusetts Institute of Technology (MIT) estimates that even if the 2015 Paris Accords (COP 21) are implemented and 1,000 new nuclear power plants are constructed, global CO₂

In 1953, President Eisenhower initiated the Atoms for Peace program.



emissions will still increase to a minimum of 64 gigatons.⁸ While this increase appears counterintuitive given the Paris agreement, it is on target because of pent-up energy demands from large populations in India, China, Southeast Asia and Africa who want to achieve the standard of living in western developed countries.

Can new atomic power reactors really help cut CO₂ by 2050? Unfortunately, what is past is prologue. The World Nuclear Association claims that 1,000 new nuclear power plants will be needed by 2050 to combat CO₂ buildup and climate change.⁹ The MIT estimate also assumes 1,000 nuclear power plants must be in operation by 2050. Using the nuclear trade association's own calculations shows that these new power plants will offset only 3.9 gigatons of CO₂ in 2050; 3.9 gigatons out of 64 gigatons is only 6.1 percent of the total CO₂ released to the atmosphere in 2050, hardly enough for the salvation of the polar bears.

If those 1,000 nuclear power plants were cheap and could be built quickly, investing in atomic power reactors might still make sense. However, Lazard Financial Advisory and Asset Management¹⁰, with no dog in the fight, has developed a rubric which estimates that the construction cost of those new power plants will be US\$8,200,000,000,000.¹¹ Yes, that's US\$8.2 trillion to reduce CO₂ by only 6 percent.

21st-century opportunities

Surely, that huge amount of money can be better spent on less expensive alternatives to get more bang for the buck. Lazard also estimates that solar or wind would be 80 percent less expensive for the equivalent amount of peak electric output.¹¹

Atmospheric CO₂ releases are not going to go on vacation while waiting for those 1,000 plants to be built. According to the World Nuclear Industry Status Report 2016, the average construction time for 46 nuclear plants that began operation between 2006 and 2016 was 10.4 years, not including engineering, licensing and site selection.¹²

Contrast that with a two-year design and construction schedule for a typical industrial-scale solar power

plant.^{13,14} Atmospheric CO₂ levels will increase by almost 70 ppm during the 35 years it will take to construct those 1,000 new nuclear power plants, an increase that they will never eliminate – if they ever operate.

Proponents of nuclear power claim that somehow, sometime in the future, atomic power reactor construction costs will be much lower and construction delays will be a thing of the past. There is no shortage of atomic reactor power ideas, according to the nuclear industry and its lobbyists, when government subsidies are used to fulfill their pipe dreams.

Global climate change is a contemporary problem that requires contemporary solutions. Governments would make the CO₂ problem worse by allocating precious resources for nuclear energy to reduce CO₂ when the cost of such proposals is unknown and when implementation only begins in 2030. Fortunately, lower-cost renewable solutions are readily available and can be implemented on the necessary time scale needed to reverse the rapidly increasing atmospheric CO₂.

Building new nuclear power plants applies a 20th century technology to a 21st century problem. Moreover, building nuclear reactors in a trade-off for CO₂ reduction creates a toxic legacy of atomic waste throughout the world. Proponents of nuclear power would have us believe that humankind is smart enough to store nuclear waste for a quarter of a million years, but at the same time, humankind is too ignorant to figure out how to store solar electricity overnight.

Let's not recreate the follies of the 20th century by recycling this atomic technology into the 21st century. The evidence proves that new nuclear power plants will make global climate change worse due to huge costs and delayed implementation periods. Lift the CO₂ smoke screen and implement the alternative solutions that are available now – faster to implement and much less expensive.

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Twists and turns in South Africa's nuclear power program

Author: Jim Green – Nuclear Monitor editor

NM835.4607 A draft energy plan recommends that South Africa's nuclear power program should be deferred – yet state-owned utility Eskom wants to press ahead.

A draft of the government's Integrated Resource Plan (IRP) proposes increasing nuclear power capacity by as little as 1.36 gigawatts (GW) by 2037, compared to a previous target of adding 9.6 GW of new capacity by 2030.¹ Start-up of new reactors is pushed back from 2023 in the 2010 IRP to as late as 2037. The government cited additional generation capacity, lower demand forecasts and changes in technology costs among the reasons for the revisions.²

Energy spokesperson Gordon Mackay from the largest opposition party, the Democratic Alliance (DA), said the draft IRP "deals a serious blow to President Zuma's attempts to finalise a corrupt and unnecessary nuclear deal. The Minister [Tina Joemat-Pettersson] must be commended for her bravery in standing against the prevailing winds of state capture and bequeathing the South African people the legal and statutory basis to challenge an irrational and ruinous nuclear deal."³

The 2010 IRP promoted nuclear power but the 2013 IRP did not – it suggested that any decision on nuclear should be deferred well into the future. However the 2013 IRP was never adopted and so only has unofficial status.^{4,5} Given that history, it is an open question whether the draft 2016 IRP will be accepted. The plan is for the draft IRP to be revised by March next year and then submitted to the cabinet for final sign-off.⁶

Eskom, which will procure, own and operate new nuclear plants, said it will still issue a 'Request for Proposals' (RFP) from international nuclear vendors by the end of this year. Eskom cited the long lead-time to build nuclear plants to justify its decision, and said that testing the market with a RFP is not the same as entering a contract. The utility said its plans are closely aligned to the 2016 IRP, but in fact Eskom envisages 6.8 GW of new nuclear capacity by 2030.⁷

Whether a RFP will elicit any responses in the current political environment is an open question. Numerous vendors have expressed interest in recent years, but the nuclear program is now shrouded in allegations of corruption, and President Jacob Zuma's days are numbered. Johan Muller from the Frost & Sullivan consultancy told Reuters: "If I was an investor or project developer in the nuclear space, I would not pick up a pen before the IRP is finalised next year to submit any request for proposals, specifically considering the dark cloud hanging over the nuclear program with alleged corrupt relationships."²

Democratic Alliance spokesperson Gordon Mackay said the RFP should be deferred until the IRP has passed public consultation and been adopted by Parliament.

He further noted that the RFP would be open to legal challenge as it would be issued "on the basis of an outdated and legally dubious Section 34 Ministerial determination, itself based on the much maligned and now out of date IRP 2010".⁸

Business 'delighted'

Hardly anyone supports South Africa's nuclear power program other than the corporates and kleptocrats who stand to directly benefit from it. Business interests, other than those with a direct interest, are overwhelmingly opposed.

The rand strengthened on the news that nuclear power was downgraded and deferred under the draft IRP.⁹

The Cape Chamber of Commerce and Industry said it is "delighted to see that the new Integrated Resource Plan (IRP 2016) says there is no need for more nuclear power in South Africa before 2037". Chamber President Janine Myburgh said: "This means that we will not have to make a decision on building new nuclear power stations for the next 10 years and by that time we will be in a better position to judge the performance and cost of renewable energy."¹⁰

The Cape Chamber added that "one worrying factor about the new IRP was that it did not include a scenario in which there were no artificial restraints on renewable energy and the effect this would have on the case for nuclear power." The draft IRP imposes annual limits on the installation of new renewable power capacity.

Dawie Roodt, an economist formerly with South African Reserve Bank, said: "We don't even need a deal like this to sink the South African economy. We are already in seriously deep trouble. If you add this to the economy, I'm afraid it's going to be fatal. This nuclear deal cannot happen now. You cannot enter into an agreement with anybody else at this stage because there's too much homework that we need to complete first."¹¹

Responding to the draft 2016 IRP's downgrading and deferral of nuclear power, Jana Van Deventer, an



Zapiro.com

economic analyst at ETM Analytics in Johannesburg, said: "It's been postponed so far down the line that by the time we get there nuclear energy might possibly be obsolete and not be a viable option anymore. This latest development potentially means that any nuclear power deal is off the table for the time being."⁹

The rise and fall of President Jacob Zuma

The likely deferral of the nuclear program is inevitably seen through the prism of President Zuma's fortunes. Zuma is scheduled to step down as leader of the governing African National Congress next year, and his second and final term as president ends in 2019.

Zuma may not last that long: he faces internal revolt within the ANC and so-far unsuccessful votes of no confidence in Parliament.^{12,13}

Bloomberg reported: "South Africa's decision to stall plans championed by President Jacob Zuma to build nuclear plants has exposed his waning authority. ... While Zuma says reactors are key to addressing power constraints in Africa's most-industrialized economy, Finance Minister Pravin Gordhan, economists and ratings companies warn that South Africa can't afford them now."¹⁴

If Zuma had his way, the most likely outcome is that Finance Minister Pravin Gordhan would have been pushed aside (indeed he never would have been appointed in the first place), the draft IRP would never have been released, and the nuclear program would be moving ahead at pace.

Robert Schrire, a politics professor at the University of Cape Town, said: "Essentially the project has been indefinitely postponed and the final decision on nuclear power will only be taken by Zuma's successor. This is a great victory for economic rationality and political expediency and reflects the new political balance of a weakened Zuma administration."¹⁴

Keith Gottschalk, a political scientist from the University of the Western Cape in Cape Town, said Zuma is "still able to out-vote and out-maneuver his opponents in the ANC, but the mounting pressure has meant he has not been able to always get his own way all the time. He is on the way down like a slow-leaking puncture."¹⁴

Corruption

The nuclear debate is occurring in the context of a wide-ranging debate over corruption. On November 2, the Office of the Public Protector released a *State of Capture* report that details evidence of corruption and is critical of the executive for failing to act on claims that there had been interference in the appointment of cabinet ministers.¹⁵ The report orders Zuma to appoint a commission of inquiry within 30 days and for it to be headed by a judge who has the same powers as the public protector.

Hartmut Winkler, Professor of Physics at the University of Johannesburg, said: "Unsurprisingly, the nuclear industry and its supporters have reacted very negatively to the new draft [IRP]. Strong nuclear advocates in the state electricity utility Eskom have gone so far as to defiantly declare that they will invite nuclear construction proposals before the end of the year. But Eskom's defiance is unlikely to lead to anything substantial.



This is because the state utility is facing both a credibility crisis and its finances are in poor shape."¹⁶

Eskom's 'credibility crisis' relates to, among other things, evidence of its questionable and possibly illegal dealings the powerful Gupta family and Gupta associates.¹⁷

Another issue taken up in the *State of Capture* report concerns the dismissal and appointment of a succession of finance ministers.¹⁸ On 9 December 2015, Zuma sacked finance minister Nhlanhla Nene, who said he wouldn't sign off on the 9.6 GW nuclear program if it was unaffordable, and wouldn't be swayed by political meddling. Nene was replaced by little-known backbencher David van Rooyen. The rand plummeted. Four days later, Zuma was forced to replace van Rooyen with Pravin Gordhan. According to the *State of Capture* report, the mystery of van Rooyen's appointment was connected to the Gupta family wielding undue political influence.^{14,19}

In November 2016, prosecutors withdrew fraud charges against Gordhan for allegedly approving a pension payment to a tax agency official. The Democratic Alliance alleged that Zuma planned to use the court case as a pretext for firing Gordhan and in the process removing the biggest obstacle to his nuclear ambitions.¹⁴

Mmusi Maimane, leader of the Democratic Alliance, said: "South Africans should be deeply concerned about the government's nuclear project. Let's be clear. It is in no way motivated by a genuine desire to secure South Africa's energy future in the most cost effective and sustainable way. Rather, this huge project is going ahead because Zuma, the Guptas and other ANC elites stand to make millions in bribes and tenders. ... In forging ahead with this ill-conceived plan, our hapless government is locking SA into an over-priced, outdated technology within Eskom's monopoly, while blocking the development of renewables which are dynamic, increasingly cost-effective and more job-creating."²⁰

Jackie Cameron sums up the current, sad situation in *Biznews*: "The twists and turns in the political stories unfolding in South Africa read like an over-the-top action thriller. There are allegations of deals struck in secret between President Jacob Zuma and Russian heavyweights. Then there are suspicions that the president's associates, including three brothers from India, have been involved in a chess-style plot to seize control of South Africa's state organisations. This strategy is going so well, the narrative goes,

that billions of rands have been siphoned out of government coffers. Add to the mix an antagonist in the form of fearless Public Protector Thuli Madonsela, who has been working tirelessly in the face of intimidation to unpack the deception. And, let's not forget an economic superman in the form of finance minister Pravin Gordhan, who is believed to be blocking a deal with Russia – and stands between South Africa and the end of the world as we know it.”²¹

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Perhaps the nuclear program will die when Zuma's presidency ends ... or perhaps there are enough kleptocrats inside the government and the state apparatus to keep it alive. Keith Gottschalk from the University of the Western Cape takes the optimistic view: "The biggest consequence of Zuma's removal would be that his cronies and agents in state departments and parastatals would be purged. This would mean the end of Zuma's reign, heralding a new era of honest government and better use of taxpayers' money.”²²

NUCLEAR NEWS

Switzerland: Referendum rejects quick exit from nuclear power

Swiss voters in a November 27 referendum rejected a proposal to impose time limits on the operation of the country's five power reactors.^{1,2,3} The proposal failed by a margin of 54:46. Forty-five percent of voters participated in the referendum.

If it had succeeded, the proposal would have imposed a 45-year lifespan limit on all reactors, leading to three closures next year and the closure of the other two reactors in 2024 and 2029.

Before Fukushima, plans were in train to build new reactors to replace the aging fleet. Applications for three new reactors were submitted to the government. The plan for new reactors was to be put to a referendum, possibly in 2012.

Days after Fukushima, the seven-person Swiss executive council (Federal Council) decided to ban the construction of new reactors. In June 2011, three months after Fukushima, the Swiss government approved a gradual phasing out of nuclear power (without specified dates for reactor closures) and reaffirmed the ban on new reactors. Despite all the twists and turns since then, that remains government policy.

The World Nuclear Association was crowing about the referendum defeat, saying that "the sensible Swiss have prioritised science and their extensive nuclear experience ahead of green energy dogma" and calling on Swiss policy-makers to remove the ban on new reactors.⁴

The World Nuclear Association asserted that the current fleet of reactors will "typically" operate for about 60 years "with most closing in the 2030s-2040s."⁵ But that

is wishful thinking. Swiss utility BKW AG already plans to close the Muehleberg reactor in 2019, citing the high costs of maintenance and upgrades.⁶ The Beznau 1 reactor has been shut down for over one year due to concerns about its pressure vessel; the regulator is currently considering an application to restart the reactor.⁷ In August 2015, all five reactors were offline for two days due to problems with two reactors and routine maintenance at the other three.⁸

Worldwide, only 22 of the 164 shut-down power reactors operated for 40 years or more.⁹ All or nearly all of Switzerland's five reactors will likely be closed by the end of the 2020s ... the same outcome as that envisaged in the defeated referendum proposal.

REACTOR	CAPACITY	COMMISSIONED	AGE (YEARS)
Beznau I	365 MW	1969	47
Beznau II	365 MW	1971	45
Mühleberg	373 MW	1971	45
Gösgen	970 MW	1979	37
Leibstadt	1190 MW	1984	32

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Progress moving from research reactors to cyclotrons for medical isotope production

A consortium of institutions led by TRIUMF, Canada's national laboratory for particle and nuclear physics and accelerator-based science, has granted sole rights for its proprietary cyclotron-based technetium-99m

(Tc-99m) production technology to ARTMS Products Inc. The license includes all the required products and procedures for the production of Tc-99m using common hospital-based and commercial cyclotrons, through the bombardment of a high-energy proton beam against specific chemical targets.

Tc-99m is used in over 80% of all nuclear medicine imaging procedures (and diagnostic imaging accounts of over 90% of nuclear medicine with palliative and therapeutic procedures making up the remainder). Typically sourced from an aging global reactor fleet, Tc-99m has been subject to occasional supply disruptions over the past decade.

"The ARTMS production technology offers many advantages, and that is why we believe our technology is truly disruptive and that it will gain widespread adoption," said ARTMS CEO Dr. Paul Schaffer. "Not only does the ARTMS production technology provide regional supply security of Tc-99m, it also offers favourable economics, and aids to eliminate the need for highly-enriched uranium, which is currently used by nuclear reactors to produce this isotope."

Dr. Jonathan Bagger, Director of TRIUMF, said the agreement with ARTMS "marks the completion of a major milestone as we move to commercialize a decentralized, green, and Canadian-made, technology that can produce Tc-99m daily at hundreds of hospital-based cyclotrons around the world. This licensing agreement marks the beginning of a new era in Tc-99m production and supply security."

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WISE/NIRS Nuclear Monitor

The World Information Service on Energy (WISE) was founded in 1978 and is based in Amsterdam, the Netherlands.

The Nuclear Information & Resource Service (NIRS) was set up in the same year and is based in Washington D.C., US.

WISE and NIRS joined forces in the year 2000, creating a worldwide network of information and resource centers for citizens and environmental organizations concerned about nuclear power, radioactive waste, proliferation, uranium, and sustainable energy issues.

The WISE / NIRS Nuclear Monitor publishes information in English 20 times a year. The magazine can be obtained both on paper and as an email (pdf format) version. Old issues are (after 2 months) available through the WISE homepage: www.wiseinternational.org

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