

HISTORY OF NUCLEAR IN SOUTH AFRICA (18 Feb 2019)

Dr Cilliers draws a thorough timeline following the inception of the new nuclear build programme in South Africa, through his personal research and experience.

Today in 2019, our country is facing one of the biggest challenges it has ever faced. Our electricity grid is near collapse and everybody is an expert on how to solve it. Nuclear build plans have been shelved because “we don’t need it right now”, the stark reality is, we have been planning to avoid this situation for a very long time. Unfortunately, it seems politics, the courts, and personal interest got in the way.

In this article, I am constructing a timeline of the progress of the nuclear build plans in South Africa based solely on publicly available information.

Year: 1993

From 1993, South Africa was developing the Pebble Bed Modular Reactor (PBMR) together with international partners. This was a new type of reactor and in 2006 it was recognised that due to uncertainty on the success of the project, South Africa needed to look at alternative electricity sources while the PBMR project was underway.

Year: 2006

In early 2006, government announced that it was considering building an additional conventional nuclear plant, possibly at Koeberg, to boost supplies in the Western and Eastern Cape provinces. This would typically be of similar technology that is used at Koeberg – Pressurised Water Reactor (PWR) technology.

To support this process an Environmental Impact Assessment (EIA) was started in 2006 confirming the selection of three possible sites for the next nuclear power units: Thyspunt (Eastern Cape), Bantamsklip (Western Cape), and Duynefontein, (close to the existing Koeberg nuclear plant).

Year: 2007-2008

The Eskom board approved a plan in early 2007 to double the country's generation capacity to 80GWe by 2025, including the construction of 20GWe of new nuclear capacity. The nuclear contribution to power would rise from 5% to more than 25% and coal's contribution would fall from 87% to below 70%.

The new programme was planned to start with up to 4GWe of PWR capacity to be built from 2010, with the first unit to be commissioned in 2016. The environmental assessment process for this 'Nuclear-1' project, which was looking at five potential sites and the preferred selection of technology, was to follow in 2008.

In late 2007 to early 2008, Eskom was hit by supply constraints, which resulted in loadshedding and subsequently sparked a nationwide drive to decrease electricity demand. This resulted in severe economic growth limitations, which are still hampering economic development. This economic impact was confirmed by the nine-point plan to respond to sluggish growth mentioned by President Zuma in the 2016 State of the Nation (SONA) address: "Resolving the energy challenge". Economic growth requires industrial development that can only be supported by large-scale stable baseload electricity supply.

It was at this point that the procurement process of Nuclear-1, a turn-key project, kicked off and Areva's EPR and Westinghouse AP1000 were short-listed. Areva headed a consortium including South African engineering group Aveng, French construction group Bouygues and EDF, which submitted a bid to supply two 1,600MWe EPR units. Westinghouse in turn offered three 1,134MWe AP1000 units. The Westinghouse-led consortium included the Shaw Group and the South African engineering firm Murray & Roberts.

In December 2008, Eskom announced that it would not proceed with either of the bids from Areva and Westinghouse, due to the lack of finance. The limited funds were due to the turn-key nature of the project, and it was decided to pursue a fleet approach that included technology transfer and contracted localisation to ensure affordability for future plans.

Year: 2010

Despite the cancellation of the Nuclear-1 bidding process, the EIA process continued and a draft environmental impact report (EIR) was published in March 2010, recommending the Thyspunt site in the Eastern Cape province near Oyster Bay, Jeffrey's Bay and Cape St Francis.

In October of that year, the Department of Energy released its draft Integrated Electricity Resource Plan (IRP) for 2010-2030, outlining the country's electricity demand; how this demand might be supplied; and what it is likely to cost.

Its balanced scenario represents the best trade-off between least-investment cost, climate change mitigation, diversity of supply, localisation, and regional development. The IRP requires 52GWe of new capacity by 2030, and assuming 3.4GWe of demand-side savings.

Year: 2011

After public consultation the IRP was revised and approved by cabinet. According to this scenario, South Africa's generation mix by 2030 should include: 48% coal; 13.4% nuclear; 6.5% hydro, 14.5% other renewables; 11% peaking open cycle gas turbine. This means that at least 9.6MWe of new nuclear capacity by 2030 is included in the plan.

To enable the introduction of 14.5% renewable energy into the system an Independent Power Producer (IPP) office with a mandate provided through ministerial determinations, similar to those mandating the implementation of nuclear projects. DoE mandates IPP Office to procure and advise with the procurement and intervention planning informed by the Department of Energy (DoE) 5-year plans.

It appeared that it was all systems go in implementing the IRP2010 plans, but at the same time a very aggressive anti-nuclear campaign was seen to be playing out in the media. It also seemed that an environment was created where wind and solar energies started competing with all other energy sources rather than supporting the proposed mix.

Nevertheless, planning for the nuclear programme stayed on course. Areva increased its involvement with the Nuclear Energy Corporation of South Africa (Necsa) and was joined by Rosatom in 2013 who declared its interest in bidding.

Bids for the nuclear programme were expected to open in 2014 so that the selected contractor could be on site in 2016, with a prediction that the first unit would be operational by 2023. Initially about 30% local content was expected in the project and could expect to rise to 40% at a later stage.

In November, the National Nuclear Energy Executive Coordination Committee (NNEECC) was established as the authority for decision-making, monitoring, and general oversight of the nuclear energy expansion programme. Cabinet endorsed a "phased decision-making approach for implementation of the nuclear programme", along with the "designation of Eskom as the owner-operator as per the Nuclear Energy Policy of 2008". One month later, the energy minister announced that around \$50 billion would be spent on nuclear capacity to 2030.

Year: 2013

An IAEA Integrated Nuclear Infrastructure Review (INIR) was carried out and later followed by an agreement signed by Necsa with Russia's NIAEP-Atomstroyexport, and its subsidiary Nukem Technologies, to develop a strategic partnership, which included nuclear power plant and waste management with financial assistance from Russia.

Commenting on this, Rosatom said that it "offers South Africa to build the entire process chain of NPP construction and operation". The strategic partnership implies joint implementation of the national nuclear power development programme of South Africa. The key project is the construction of new NPPs with the Russian VVER reactors totalling 9.6GW (up to 8 power units) in South Africa.

"Besides, the parties intend to build a research reactor to the Russian technology, which would lay the basis for joint business in the area of isotope production and sales in the international market."

Year: 2014

The 2014 SONA was the first address where the nuclear programme was mentioned explicitly with President Jacob Zuma saying: “We continue to explore other sources of energy, in line with the Integrated Resource Plan for Energy. [...] Having evaluated the risks and opportunities, the final regulations will be released soon and will be followed by the processing and granting of licenses. We expect to conclude the procurement of nine thousand six hundred megawatts of nuclear energy.”

Rosatom signed an agreement with South Africa’s energy minister in September to advance the prospect of building up to 9.6GWe of nuclear capacity by 2030. The minister said: “This agreement opens up the door for South Africa to access Russian technologies, funding, infrastructure, and provides proper and solid platform for future extensive collaboration.”

It is expected to involve some \$10 billion in local supply chain provision, with localisation of 60%. Necsa later said that the new agreement "initiates a preparatory phase for the procurement process for the new nuclear build in South Africa. Similar agreements will be signed with other vendor countries that have expressed an interest in assisting South Africa with the build programme. No vendor country has been chosen yet and no technology has been decided. The agreement refers only to what Russia could provide if chosen".

In October a nuclear cooperation agreement with France was signed. On this, the Minister of Energy said: "This paves the way for establishing a nuclear procurement process." Areva welcomed the agreement, and said that it was ready to support the development of new South African nuclear projects, “notably through its Generation III+ EPR reactor technology."

A similar inter-governmental cooperation agreement was signed with China in November. The energy ministry said that the agreement "initiates the preparatory phase for a possible utilisation of Chinese nuclear technology in South Africa."

Three further agreements in December were established between Necsa and China National Nuclear Corp (CNNC) to enable a cooperative partnership supporting the country’s nuclear industry, between SNPTC, the Industrial & Commercial Bank of China and South Africa's Standard Bank Group.

Year: 2015

In February, Necsa signed a further skills development and training agreement with SNPTC and China General Nuclear Power Corp (CGN), of which China is funding around 95%. Agreements with the US and South Korea were put in place, and a further agreement is pending with Japan.

The President's annual state-of-the-nation address in February 2015 reaffirmed the 9.6GWe target with the first unit expected to come on line in 2023. The President highlighted that bids would be sought from the US, China, France, Russia and South Korea.

In May, the energy minister said that the procurement process for the new nuclear power plant would begin in September, and she expected that a strategic partner would be selected by March 2016. In June Eskom ceded control of the new build programme to the Department of Energy.

In addition, the department of energy issued its Strategic Plan 2015-2020, which was approved by the Minister of Energy. Here the nuclear power and technology are mentioned as a strategic driver to transform the South African economy: "The DoE further aims that both traditional and green energy will be expanded to ensure a platform for growth and social inclusion. This will include the use of nuclear power for baseload energy generation, which will be used in a safe and environmentally sustainable manner. [...]"

"In terms of the approved Integrated Resource Plan (IRP), nuclear energy will play a key role to support the baseload generation capacity in the energy future of our country, given the need for the country to decarbonise [...]"

Meanwhile, the EIA was in its final public review period from 23 September to 25 November 2015 and in December 2015, following cabinet approval, the Department of Energy issued its Request for Proposal for 9,600MWe nuclear power capacity.

Year: 2016

Zuma delivered his annual state-of-the-nation address in February, where he again confirmed the 9.6GWe nuclear capacity target: “The nuclear energy expansion programme remains part of the future energy mix. Our plan is to introduce 9,600MW of nuclear energy in the next decade, in addition to running Koeberg Nuclear Power Plant. We will test the market to ascertain the true cost of building modern nuclear plants. Let me emphasise that we will only procure nuclear on a scale and pace that our country can afford.” During the same month, the Energy Minister recommended that the nuclear programme be incorporated into the independent power producer (IPP) office.

Early March 2016, the final EIA report was submitted to the Department of Environmental Affairs for approval. On 9 March, the Department of Energy Director General Thabane Zulu announced that South Africa plans to issue a request for proposals to build at much as 9,600 megawatts of nuclear power- generation capacity by the end of the month, he said: "The project-cycle pipeline that we have put in place is to do it at the end of the March," and, “The markets will determine what will be the best, cost-effective method. The state can then look at the results and “be better positioned to decide on the course."

September 2016 Necsa stressed that the field was wide open and that an initial contract might be for up to three PWR units, about one-third of the total, with an operating reference plant in the country of origin. It did not want a BOO arrangement or a turnkey contract, but favoured a build-own-transfer model such as in the UAE. Eskom said that there was a high level of interest in response to the December 2015 request with formal responses due by the end of April 2017.

In November 2016 an updated IRP was revised the nuclear build target in its base case to 6.8GWe coming online 2037 to 2041, and 20.4GWe by 2050. Nuclear would contribute 30% of electricity from 14% of capacity, compared with coal 31% from 18% capacity. In 2050, 37.4GWe of wind would contribute 18% of the supply, and 17.6GWe of solar PV would contribute 6.5%.

The report noted that the final updated IRP will differ from the base case due to the impact of a number of scenarios under consideration. Under the carbon budget scenario, new nuclear was likely to come online around 2026. Eskom would continue to proceed with its request for

proposals at the 9.6GWe level and anticipated that levelised generation cost of R1000/MWh would be achieved.

In December 2016 Treasury withdrew authorisation for the RFP and toned it down to a non-binding request for information (RFI) instead, handled by Eskom.

Year: 2017

In April 2017, before the deadline of the RFI, the Western Cape high court set aside the intergovernmental nuclear cooperation agreements with Russia, US and South Korea, along with approvals by the National Energy Regulator of South Africa (NERSA) of two ministerial determinations concerning the procurement of 9.6GWe of nuclear capacity.

- The ministerial determination signed in November 2013 and gazetted in December 2015 for a 9.6GWe nuclear new build program in South Africa was declared invalid.
- The ministerial determination of December 2016 appointing Eskom as the procuring agent for the nuclear new build was set aside, as was Eskom's RFI of December 2016 before the submission deadline of end-April 2017.
- Ministerial determination mandating actions of the IPP office was not included in the case, and as a result did not suffer the same fate – the nature and scope of these determinations, however, are very similar.

In response, the new finance minister, Ms Mmamoloko Kubayi, said that the government would “implement the [nuclear] programme at the scale and pace the country can afford” on the basis of the IRP.

In the meantime, after signing 3 rounds of IPP bid window power purchase agreements Eskom started refusing to sign any more PPAs, which the industry says is illegal as the bidding process effectively amounts to the awarding of a tender.

On September 1, Minister Kubayi unexpectedly announced a solution to the impasse, which affects 27 preferred bidders waiting to spend R60 billion on building mostly wind and solar power plants.

Her solution was that they drop the tariffs government had agreed to in 2015 and that, in return, Eskom will almost immediately sign the PPAs. However, some of the projects are unviable at 77c/kWh, and even the ones that can physically be done at that price will be far less profitable than their developers and financiers had expected.

Minister Kubaye stated: “My responsibility is to protect the state. The facts before me show certain grounds and I cannot blindly ignore them. Some of [the IPPs] are ridiculous. Some of the financing deals are abhorrent,” she said. “The ratings agencies are on our case about the guarantees.”

On 18 October 2017, the Department of Environmental Affairs granted Environmental Authorisation for the proposed construction and operation of the Eskom Nuclear Power station at Duynefontein in Western Cape after the Thyspunt and Duynefontein sites were the only two sites that progressed to the Final Environmental Impact Report (FEIR) phase and were presented as viable sites for this proposed development.

Things soon started to change...

Year: 2018

With the change of leadership in South Africa, on 4 April 2018, at the signing event in Pretoria Energy Minister Jeff Radebe declared a “new dawn” for renewable energy in South Africa, following a “long period of uncertainty, not only for the renewable-energy industry, but also for private sector investment in the energy sector”. The power purchase agreements were signed disregarding the cautions by Minister Kubaye in 2017.

In August 2018, the new administration under President Cyril Ramaphosa released a draft IRP that does not foresee any new nuclear capacity before 2030. Post-2030, the draft IRP calls for detailed technical, cost, and economic benefit analysis of "other clean technologies such as clean coal technology, nuclear and others".

The Parliamentary Portfolio Committee on Energy conducted public hearings subsequent to the release of the Draft IRP 2018 and released a report on 27 November 2018.

Concerning nuclear, the finding was very clear: “The PCE has noted the submission by the DoE that nuclear was included in the scenarios; it was modeled as a fleet, in the form of two units, at 1,500MW per unit and in a short space of time of up to 2030, nuclear becomes the most expensive technology. This was a matter of scalability, modularity, and electricity demand - there was no pre-determined decision to exclude nuclear as such. There is no persuasive argument to counter the proposition that nuclear technology remains the cleanest, safest and in the long term the cheapest technology.”

In its recommendations it stated: “That the IRP should make it explicit that both coal and nuclear will remain important elements of South Africa’s energy mix. In the case of coal, new clean coal technologies should be pursued.”

In this time, South Africa was hit by rolling blackouts again, it appeared that the aging coal fleet was aging faster than expected, this was exacerbated by the fact that Eskom reduced its maintenance plans to only cover plant breakdowns, Eskom also started a process of retrenching its most experienced staff (the senior executive managers).

Year: 2019

In an apparent disregard for the PCE findings, as well as the public participation process, Energy Minister Jeff Radebe said on 16 January 2019, South Africa is aiming to finalise a long-term plan for the country’s energy mix next month, and once that is done it will launch another round of renewable energy deals. “We are aiming for February,” Radebe told Reuters, when asked when the Integrated Resource Plan (IRP) would be completed. “Straight away after that, we will launch more renewable energy contracts,” he added.

So, here we are, February 2019, 11 years after the first loadshedding, South Africa just faced the worse round of loadshedding (stage 4 – shedding 4,000MW), the availability of the coal fleet is at an all-time low. We have spent R200 billion on renewable energy projects that do not seem to make any dent in the lack of supply (how can it, solar PV do not supply during high demand time, and wind is intermittent). Yet, nuclear is still not part of the conversation.

Had South Africa followed through on the IRP2010, instead of playing politics and taking each other to court, we might have been talking about growing the economy right now. It may well be too late.