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Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor:

- Tim Judson writes about the nuclear lobby's antics at the UN COP23 climate conference in Germany.
- A detailed report on Saudi Arabia's plans to develop nuclear power and a latent nuclear weapons capability.
- Pete Roche writes about the scandalous mismanagement of decommissioning projects in the UK.

The Nuclear News section has reports on the economic failure of nuclear power; and a former chair of India's nuclear regulatory board calling for a freeze to the country's nuclear power program.

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.

Email: monitor@wiseinternational.org

Monitored this issue:

Global warming and nuclear hot air at COP23: nuclear front groups attempt to confuse the climate debate

Author: Tim Judson – Executive Director, Nuclear Information & Resource Service

NM854.4690 Nuclear power companies and promoters of the technology turned up their appeals for special treatment in November at COP23, the United Nations' global climate conference, held in Bonn, Germany.

What got the most attention were two high-profile promotional events that drew considerable protest from civil society groups at the conference: a November 13 forum held by the US delegation, promoting 'The Role of Cleaner and More Efficient Fossil Fuels and Nuclear Power in Climate Mitigation'; and a November 15 presentation by Rosatom promoting 'Russia's Contribution to Low-emission Economies', particularly through nuclear reactor exports and natural gas extraction.

In addition, trade associations and professional organizations, from the European Nuclear Society to the Japan Atomic Industrial Forum, held yet more events and staffed exhibit booths throughout the conference. They were also joined by an astroturf presence consisting of front groups, such as Energy for Humanity and Generation Atomic, which held press conferences and were a vocal presence at COP23 events. One such event was held by Environmental Progress (EP) with climate scientist and nuclear power promoter James Hansen titled, 'Nuclear Power? Are Renewables Enough?'

The EP presentation promoted the release of a report, titled 'The Power to Decarbonize', which was also covered in the *New York Times* on November 7. The central thesis of EP's report is that renewables are less effective than nuclear at reducing the carbon intensity of energy supplies. This may seem like a strange metric for evaluating climate action strategies, and for

good reason: carbon intensity is the rate of carbon emissions per unit of gross domestic product, not the actual amount of greenhouse gas emissions, or the rate of change in those emissions. Rapid economic growth could disguise large increases in carbon emissions; whereas economic stagnation could turn decreased emissions into an increase in emissions intensity.

The EP report is replete with similar types of statistics, such as electricity generation per capita (kWh per person), the relevance of which is at best secondary to evaluating the climate impacts of energy technologies – particularly given high rates of population growth in many countries. The report also uses arbitrary and inconsistent time periods, selecting the 11-year periods of the fastest development of nuclear power in nine countries – again, measured in energy units per capita – versus a uniform 11-year period for renewable energy (2004–2014) in eight countries, only three of which are the same. The rate of renewable energy growth has only begun to take off globally since 2010, so EP's basis for comparing nuclear and renewables is inherently skewed, including several years with no meaningful data for most countries. In addition, the analysis is skewed because of the enormous increase in global population between the periods EP analyzed for nuclear (mostly ending in the 1980s) and renewables (ending in 2014).

As a case in point, EP's analysis leaves out one of the most important factors in reducing greenhouse gas emissions: how quickly energy sources can be built. For instance, EP's report cites the period 1981–1991 for nuclear in the US, but neglects to show that many of the reactors that came online in that time period took well over a decade to build. In contrast, wind and solar projects are typically developed in 2–5 years. Take, for instance, the state of Texas in the US, which developed 15,000 MW of wind from 2006–2015, generating as much electricity per year as all four of the state's nuclear reactors; the reactors all came online within five years of each other (1988–1993), but each took 14-20 years to permit and build. Over a similar time-frame (2000–2016), Texas built about 20,000 MW of wind, generating 50% more electricity than nuclear.

Anti-nuclear protest at the UN COP23 climate conference, Bonn, November 2017.

Similarly, the V.C. Summer 2 and 3 reactors in the US state of South Carolina were canceled in July 2017, nine years after beginning the permitting process. Construction of the reactors is less than 40% complete, with US$9 billion spent on the project and an estimated $17 billion more to complete. Utility customers in the state are reportedly paying 18% of their monthly bills toward the abandoned reactors. Had South Carolina utilities begun investing in renewables and efficiency 10 years ago instead of planning the nuclear project, South Carolina would have significantly reduced greenhouse gas emissions, at a far lower cost.

What matters in deciding how to reduce greenhouse gas emissions is how quickly fossil fuel energy sources can be reduced and phased out, at what cost, and with what social and environmental impacts. Nuclear is failing on all counts, in nearly every country where reactors are being developed. EP and other nuclear promoters' use of obscure, inconsistent, and in many cases arbitrary statistics amounts to pseudo-scientific handwaiving – confusing the discussion of energy choices and climate action strategies.

Anti-nuclear protest at the UN COP23 climate conference, Bonn, November 2017.

Is Saudi Arabia going nuclear?

Author: Jim Green – Nuclear Monitor editor

NM854.4691 Saudi Arabia is taking active steps towards the construction of two power reactors. If built, they will be the country's first. The government agency in charge of the nuclear plans, the King Abdullah City for Atomic and Renewable Energy (KACARE), sent a Request for Information (RFI) to potential suppliers in October, marking the first step towards a formal tender process. KACARE hasn't commented on the RFI process, but three sources confirmed it to Reuters[1] and Rosatom's Alexei Likhachev said the RFI was sent to "a parade of vendors prepared to build a major nuclear power plant".[2]

KACARE president Hashim bin Abdullah Yamani said in September: "We are carrying out feasibility studies, technically and economically to build those nuclear reactors ... in addition to detailed technical studies for the selection of the best locations."[3] Maher al Odan from KACARE said the Kingdom hopes to award reactor construction contracts by the end of 2018.[4]

The Kingdom's nuclear program has been slowly taking shape over the past decade:[5]

- In 2006, Saudi Arabia and other members of the Gulf Cooperation Council announced the commissioning of a study on the development of nuclear power.
- The Gulf Cooperation Council initiative stalled but in 2009 Saudi Arabia announced it was considering developing its own nuclear power program.
- In April 2010, King Abdullah issued a royal decree stating that development of atomic energy is essential to meet the Kingdom's growing energy requirements.
- In 2011, plans were announced for the construction of 16 power reactors, and WorleyParsons was commissioned to identify potential sites.[6]
- Three sites were short-listed in 2013. An April 2013 timeline envisaged construction starting in 2016.[6]
- The plan for 16 reactors was re-announced in September 2014, with a completion date of 2032.
- In January 2015, the 2032 completion date was pushed back to 2040.
- Korea Atomic Research Institute, and a subsidiary of South Korea's KEPCO, won contracts in 2015 and 2016 to carry out feasibility and planning studies.[7]
- In July 2017, the Cabinet approved the establishment of a National Project for Atomic Energy.[6]

KACARE's website, which isn't updated as often as it should be, still promotes the pre-2015 plan is to have 17.6 gigawatts of nuclear capacity (16 reactors) in operation by 2032.[8] Reuters says the construction of more reactors beyond the first two is a "longer-term" project[9] while pro-nuclear commentator Dan Yurman says the larger 16-reactor project "was abandoned due to costs and complexity."[10]

Suppliers

Companies, utilities and consortia from several countries – South Korea, China, France, Russia, Japan and the US – are interested in constructions contracts and other work for a Saudi nuclear power program.[11] Several countries have been working hard for some years to put themselves in prime position.[6,11] Saudi Arabia has nuclear cooperation agreements with numerous countries including South Korea, China, France, Russia, Kazakhstan, Argentina, Finland, Hungary, and Indonesia.[6,12]

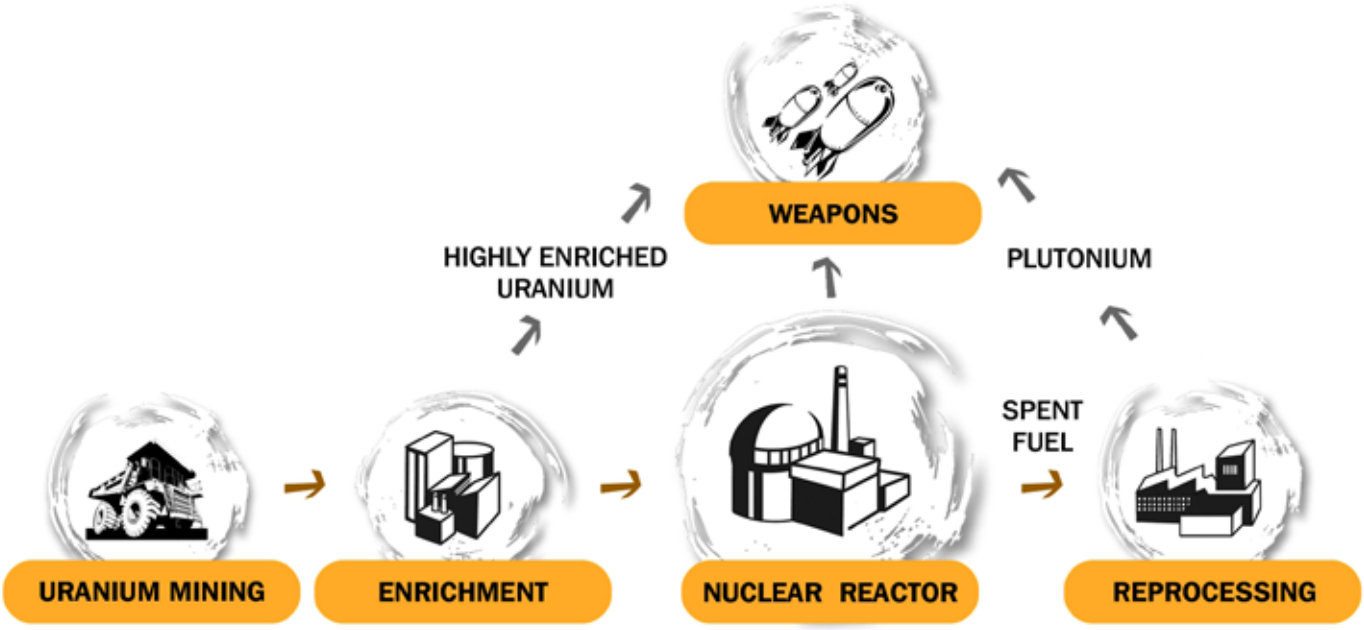
It's anyone's guess what sort of lobbying is going on to secure Saudi reactor contracts and what sort of horse-trading is going on. And it's impossible to know how widespread corruption in Saudi Arabia[13] – and current efforts to address endemic corruption, if that's an accurate way of characterizing the recent detention of hundreds of Saudis[14] – will shape the nuclear contracting process.

Two committees in the US House of Representatives are investigating efforts by former US National Security Advisor Mike Flynn to enlist Russia's Rosatom in a deal to deliver nuclear reactors to Saudi Arabia.[10] An analysis by *ProPublica* details the efforts of Flynn and others to broker nuclear deals between potential suppliers (US, European, Arab, Russian and Chinese companies) and potential buyers in the Middle East (Egypt, Jordan and Saudi Arabia).

Rationale

Saudi Arabia wants to diversify its energy sources – hence its plans to introduce nuclear power and to expand renewables and energy efficiency programs. There is no serious pretence that reducing greenhouse emissions is a significant policy driver. On the contrary, one reason repeatedly advanced for the nuclear program is to increase fossil fuel exports, and tied in with that is a push to do more value-adding by operating more oil refineries rather than exporting crude oil.[15] KACARE states that alternative energy sources will ensure "longer-term availability of hydrocarbons for export"[16] and will facilitate the use of petroleum "for higher value purposes and export".[17] Likewise, Prince Turki al-Faisal said in 2016 that "we need to conserve as much oil as possible for export and sale."[15]

In addition to its plans for two large reactors, Saudi Arabia is also exploring options for small modular reactors (SMRs). And again, reducing greenhouse emissions isn't the driving force: one of the reasons given by KACARE for the interest in SMRs is their use for process heat applications including in petrochemical plants.[3,18] Saudi Arabia has been in discussion with Argentina (which is building a 25 MW SMR), China (which is building a small high temperature gas-cooled reactor) and South Korea (which has designed and licensed a small pressurized water reactor – but doesn't plan to build any at home).[6]



Does nuclear make sense in the context of efforts to diversify energy supply? Perhaps ... assuming that the costs were in the same ball-park as the South Korean-led project to build four reactors in the United Arab Emirates (around US$20 billion – though it is widely believed that the true cost of the project is higher). The nuclear program might also make some sense if numerous reactors are built; conversely, the significant start-up costs associated with establishing a nuclear workforce, a regulator and so on would make little sense if the program is limited to two reactors.

In an April 2015 paper, M.V. Ramana and Ali Ahmad compared electricity generation costs from nuclear reactors with natural gas, solar PV and concentrated solar power stations.[19] They concluded that unless natural gas prices rise dramatically, that would remain the cheapest source of electricity generation, less than half as expensive as nuclear. Replacing oil based power plants with nuclear – or natural gas – would make economic sense.

Ramana and Ahmad write:[19]

"The real surprising result that came out of our analysis was that solar technologies are very competitive with nuclear reactors. The key point is that it would take at least a decade, quite possibly more, for a country like Saudi Arabia to generate its first unit of nuclear electricity, even if the decision were to be made tomorrow, and solar photovoltaic and concentrated solar technologies have both been experiencing dramatic declines in prices. Based on current trends, the cost of electricity from solar plants would become cheaper than from nuclear plants around the end of this decade or soon after in areas like the Middle East with ample sunshine. Nuclear reactors, in contrast, are not becoming cheaper. Some studies find evidence of "negative learning" wherein nuclear costs rise as more reactors are constructed."

The paper by Ramana and Ahmad was written less than three years ago but it is already out of date. They cite an estimate of US$11 billion for the two-reactor V.C. Summer project in South Carolina. But estimates for that project – which was abandoned in mid-2017 – rose to US$25 billion including interest, or US$18 billion excluding interest.[20] Nor would nuclear power make economic sense if the reference point was the catastrophically over-budget EPR reactors being built in France or in Finland.

There is some dispute within Saudi Arabia about the economic viability of nuclear power. In May 2016, Ibrahim Babelli, acting deputy minister in the Ministry of Economy and Planning, said that not only was solar power cheaper, but it also lacked the security risks that come with nuclear power.[21] Babelli said: "We have a God-given solution with solar, and with storage – especially CSP [concentrated solar power] with storage, that we can meet baseload demand. But we're only able to do that if we divorce our thinking and decision-making from what our international friends say because it's not for Saudi Arabia."

In May 2016, Saudi Arabia set a target of building an "initial" 9.5 GW of renewable power capacity by 2023, mostly solar and wind, as the "first stage" of a more ambitious program.[22] As with the nuclear program, renewable energy targets have come and gone, they have been increased and decreased, brought forward and deferred ... all without a lot of action. But there has been some movement this year to promote the expansion of renewables.[23-27] Thamer Al-Sharhan, managing director of ACWA, Saudi Arabia's leading renewable energy developer, said in January that he has heard a number of promising plans over the past six years that didn't materialize, but this time he has genuine optimism.[26] Thirty renewable energy projects have been announced and work has begun on some of them.[28]

Saudi Arabia's first major tender for solar power (300 MW) has recently been completed. The lowest bid was just US1.79c/kWh or US$17.9/MWh – with no subsidies. Six of the seven lowest bidders offered prices below $US30/MWh. Giles Parkinson wrote in *RenewEconomy*: "The stunning offer ... represents a significant fall of 75 per cent in costs below those considered 'not credible' less than two years ago."[29] Ironically, the lowest bid was from French utility EDF and UAE-based Mascar. EDF will be paid a guaranteed US$122.7/MWh for power from the Hinkley Point reactors it is building in the UK – almost seven times greater than its solar bid.

A weapons agenda?

It is no secret that Saudi Arabia is leaving open the option of building nuclear weapons. For example:

- In 2009, according to former senior US diplomat Dennis Ross, King Abdullah told him: "If they [Iran] get nuclear weapons, we will get nuclear weapons."[30]
- In 2011, Prince Turki Al-Faisal, a former long-term head of Saudi Arabia's intelligence agency, said: "It is in our interest that Iran does not develop a nuclear weapon, for their doing so would compel Saudi Arabia ... to pursue policies that could lead to untold and possibly dramatic consequences."[31]
- Nawaf Obaid from the King Faisal Center for Research and Islamic Studies in Riyadh, and Special Counselor to Turki Al-Faisal, said in December 2013: "But what is clear, and here there should be no room for misinterpretation or misunderstanding, is that if the Iranians are allowed to keep "an enrichment capability" that will over the medium- to long-term make them a *de facto* nuclear power, then Saudi Arabia, in keeping with its new emerging strategic doctrine, will have no choice but to go nuclear as well."[32]
- In April 2014, Turki al-Faisal said: "Preserving our regional security requires that we, as a Gulf grouping, work to create a real balance of forces with [Iran], including in nuclear know-how."[33]
- In a May 2014 paper, Nawaf Obaid wrote: "Of course, if Iran gets nuclear weapons (with Israel already having a nuclear arsenal), KSA will be forced to follow suit. Thus, KSA should explore its nuclear provision options in order to prepare for a very likely nuclear Iran in the medium-to-long term. ... If such a scenario occurs, KSA will initiate a domestic nuclear weapons program within a yet to be specified time-period to counter Iran's acquisition. A credible nuclear strategy would mandate that a rapid nuclear deterrent be obtained in the short term and that the establishment of an indigenous nuclear weapons program take shape over the medium- to long-term."[34]
- In May 2015, Turki al-Faisal threatened to match Iran's nuclear program: "Whatever the Iranians have, we will have too."[35]
- In January 2016, Turki al-Faisal said: "In a speech I gave four years ago in the kingdom and subsequently reiterated, I said that should Iran acquire nuclear weapons, Saudi Arabia and the Gulf Cooperation Council (GCC) must look at all the available options to meet the potential threat that will come from Iran – including the acquisition of nuclear weapons. I don't think we should close the door to ourselves before we see what is going to happen with Iran. And if that means that we go to develop nuclear weapons, then that is a choice that will have to be made by the GCC leadership, as I recommend, to meet that challenge."[15]
- In June 2016, the Saudi ambassador to the UK, Prince Mohammed bin Nawwaf, said the kingdom was keeping "all options ... on the table" in a confrontation with Iran.[36]

Regardless of intent, a nuclear power program would bring Saudi Arabia far closer to a weapons capability. The reactor-grade plutonium produced in the normal course of operation of a reactor can be used in weapons, or reactors can be operated on a short irradiation cycle to produce weapon-grade plutonium. In addition, a nuclear power program would necessarily entail the development of significant nuclear science and engineering expertise which could be redeployed to a weapons program. A nuclear power program could justify the acquisition of other technologies − such as enrichment and reprocessing technology, and research reactors − which might be put to use in a weapons program. (Argentina's INVAP is building a very low power research reactor in Saudi Arabia[37] and an October 2017 agreement between KACARE and Russia's Rosatom envisages construction of another research reactor in the Kingdom.[6])

There is a long-running debate about whether a nuclear power program or a nuclear research reactor program makes more sense for a would-be weapons state. Power reactors produce large amounts of fissile material in a short space of time and they can more easily be used to justify the development of enrichment technology or a large-scale reprocessing capability ... but nuclear power programs are very expensive. Research reactor programs are relatively cheap, and they often involve a small-scale reprocessing capability (hot cells) ... but the fissile material production rate is generally low. That debate may need reframing if small modular reactors are developed – they might be the technology of choice for the modern proliferator.[38]

Most likely, Riyadh seeks to develop a latent nuclear weapons capability under cover of a peaceful program, but dedicated pursuit of nuclear weapons would need to weighed against potential problems such as worsening Saudi Arabia's security environment (e.g. by encouraging other states to build nuclear weapons), rupturing strategic ties with the US, damaging the country's international reputation and making the Kingdom the target of sanctions.[39]

A March 2017 analysis by the Institute for Science and International Security states that there is "little reason to doubt that Saudi Arabia will more actively seek nuclear weapons capabilities", motivated by Iran's nuclear program and the limitations of the 2015 Joint Comprehensive Plan of Action between the P5+1 and Iran.[40] It further states that "Saudi Arabia now has both a high disincentive to pursue nuclear weapons in the short term and a high motivation to pursue them over the long term".

Clearly there is some interest in developing a latent or threshold weapons capability. But why would senior people in the Saudi regime say so openly? One answer is that the regime may be seeking to leverage formal defense commitments from the US, and greater access to conventional weapon systems such as the F-35 advanced fighter.[41] The Trump administration is willing to expand conventional arms sales to Saudi Arabia[42] – but there's no evidence and little likelihood that the administration is motivated by a desire to stop Saudi Arabia developing nuclear weapons. Washington has

reportedly rebuffed the formal defense pact sought by Saudi Arabia. Writing in *The Nonproliferation Review*, Tristan Volpe says that the threat to build nuclear weapons lacks plausibility given the rudimentary state of Saudi Arabia's nuclear industry.[43] If that's the case, the threat will presumably be taken more seriously if and when Saudi Arabia has power reactors and a small army of trained nuclear experts.

Developing threshold capabilities

Earlier this year, KACARE president Hashim Bin Abdullah Yamani said Saudi Arabia is committed to international conventions and treaties as well as the guidance provided by the International Atomic Energy Agency.[44] Such claims would be more compelling and comforting if they were true.

There are numerous indications that Saudi Arabia is steering its nuclear program in such a way as to lower the barriers to weapons production, and no contrary indications:

- Saudi Arabia seems to be seeking to develop the capacity to build its own reactors.
- It is working to deepen and broaden its domestic nuclear expertise.
- As of July 2017, 183 countries had signed and 166 countries had ratified the Comprehensive Test Ban Treaty; Saudi Arabia has not signed or ratified the treaty.[52]
- It does not have an Additional Protocol to its IAEA safeguards agreement, which would allow for more intrusive inspections.
- It is refusing to follow the UAE's lead and forego the option of developing enrichment or reprocessing technology.
- It is seeking to develop its own uranium reserves despite the existence of plentiful, cheap uranium on the international market.

At least two nuclear cooperation agreements – with South Korea and China – contain language about technology transfer suggesting Riyadh may be seeking to develop the capacity to build reactors. The agreement with South Korea concerning 'SMART' SMRs envisages significant technology transfer such as, in the words of the World Nuclear Association, "a partnership to establish knowledge infrastructure in SMART technology fields, such as designing and building the reactors".[6] Likewise, a 2017 China / Saudi agreement envisages "cooperation in intellectual property and the development of a domestic industrial supply chain for HTGRs [high-temperature gas-cooled reactors] built in Saudi Arabia."[45]

The March 2017 analysis by the Institute for Science and International Security states: "Saudi Arabia has expressed interest in developing an indigenous capability to manufacture nuclear reactors. KA.CARE, the national agency at the forefront of Saudi Arabia's nuclear agenda, has identified several steps within the nuclear fuel cycle as having high potential for local manufacturing, including fuel fabrication, processing, and enrichment. Going beyond the import of technologies, Saudi Arabia appears to have intentions to acquire intellectual property rights and become an exporter of small modular reactors (SMRs)."[40]

Saudi Arabia aims to train a largely local workforce to run its nuclear plants according to Noura Youssef Mansouri, a Saudi energy expert and a manager with Areva in Riyadh.[46] The Institute for Science and International Security report states: "Overlooked by many experts evaluating Saudi Arabia's nuclear future is the fact that the country's nuclear workforce is increasing at a rapid pace in both quality and quantity. The academic nuclear engineering sector is growing substantially, constantly launching new graduate programs and expanding Saudi Arabia's five nuclear research centers."[40]

Prince Turki al-Faisal has clearly linked the build-up of nuclear expertise under the civil nuclear program with the desire to move towards a weapons capability. Following the July 2015 nuclear agreement between Iran and the P5+1, al-Faisal said "we have no illusions about our capabilities ... so that's why we began a very extensive training and skills acquisition program", and he noted that the 15-year sunset clause in the Iran deal was a key reason why "the Kingdom's program for capacity building on the issue of nuclear energy is so vital and necessary and important."[15]

KACARE has that said the country's intention is to oversee a large proportion of the fuel cycle domestically from the outset and to be 65% self-reliant by 2032. Nick Butler commented in the *Financial Times*: "Such an aspiration is valid under the terms of the Non Proliferation Treaty but will inevitably provoke scrutiny. The decision contrasts with the choice by the UAE – another state developing nuclear power capacity – to buy from outside rather than seeking a fuel cycle capability of its own."[47]

Saudi Arabia is seeking "self-sufficiency in producing nuclear fuel" according to Hashim bin Abdullah Yamani, head of KACARE.[50] That includes exploitation of domestic uranium reserves. "We utilize the uranium ore that has been proven to be economically efficient," Yamani said.[50]

But exploitation of Saudi Arabia's uranium reserves – which KACARE estimates at about 60,000 tonnes[50] – is the exact opposite of economic efficiency. It makes no economic sense whatsoever to be starting up a uranium industry from scratch when uranium is plentiful and cheap on the international market, with no likelihood of that situation changing in the foreseeable future.

Of course, "self-sufficiency in producing nuclear fuel" makes sense if the aim is to develop a threshold nuclear weapons capability.

Sensitive nuclear technologies

In 2008, Saudi Arabia and the US signed a 'Memorandum of Understanding on Nuclear Energy Cooperation' in which Saudi Arabia stated its intent to rely on international markets for nuclear fuel and to not pursue sensitive nuclear technologies (enrichment and reprocessing).[48] But a formal agreement between the two countries has not proceeded because of Saudi Arabia's unwillingness to forego enrichment and reprocessing.[49]

There is no indication that any other potential supplier states will insist on Saudi Arabia foregoing enrichment and reprocessing.

Saudi Arabia has commissioned at least one feasibility study on its potential involvement in all stages of the nuclear fuel cycle; the engineering consulting firm found that mining and enriching domestic uranium deposits were among the feasible options.[40]

The primary purpose of the IAEA's low-enriched uranium bank – opened this year in the city of Oskemen in Kazakhstan – is to limit the spread of enrichment technology.[51] But it won't stop countries intent on developing nuclear weapons, or a threshold weapons capability, from pursuing enrichment or refusing to forego the option of pursuing enrichment.

Safeguards

Saudi Arabia concluded a 'Comprehensive Safeguards Agreement' with the IAEA in 2009. But Riyadh only agreed to an earlier version of the 'Small Quantities Protocol' (SQP) and has yet to accept the modified SQP adopted by the IAEA Board of Governors in 2005. Moreover, Saudi Arabia has conspicuously failed to sign an Additional Protocol which would allow for more intrusive and wide-ranging IAEA inspections.[53]

Saudi Arabia, under its current SQP obligations, could secretly build enrichment technology and need only tell the IAEA 180 days before introducing nuclear material − R&D, mechanical testing of centrifuges, and testing with surrogate materials, need not be revealed.[54]

Canadian officials have expressed concerns about the potential for Saudi Arabia to pursue nuclear weapons. "Minimal safeguards are in place in SA [Saudi Arabia] to verify peaceful uses of nuclear energy ... and it has refused to accept strengthened safeguards," officials said in an assessment prepared for Canada's Foreign Affairs Minister in March 2012. "Many observers question SA's nuclear intentions, especially if Iran were to acquire a nuclear weapons capability. As a result, SA does not meet Canada's requirements for nuclear cooperation."[55]

So will any suppliers insist on an Additional Protocol being in force as a precondition of nuclear supply? Not likely. The formal policy of Australia – a potential uranium supplier – is that customer countries must have an Additional Protocol in force. But Australia has a long history of putting uranium sales first and proliferation concerns last, so the policy might be waived – just as Australia's policy of refusing sales to non-NPT states was waived for India. Or Saudi Arabia might do what India and others have done – negotiate an Additional Protocol that is so weak it isn't worth the paper it is written on.

Proliferation in the Middle East

Iran's nuclear program was in part a response to those of Israel and Iraq. Saudi Arabia's program is motivated in part by those of its regional rivals. The UAE's agreement to forego enrichment and reprocessing could have tempered proliferation risks in the Middle East. But the UAE agreement is shaping up as an exception rather than the new norm – such that the UAE itself is wavering on its commitment to forego enrichment and reprocessing.[40,49]

A Saudi Arabian nuclear program without a binding commitment to forego enrichment and reprocessing will further fuel regional proliferation risks. The Institute for Science and International Security states:[56]

"In the Middle East, the perceived strategic, political, and military advantages derived from having the ability to enrich nuclear fuel to weaponization levels or to separate plutonium will be too strong for many governments to resist, even in the absence of a full-blown nuclear weapons effort. This dynamic will severely challenge global nonproliferation regimes and agreements as more and more countries strive, overtly or covertly, to become members of "nuclear fuel club," or on the threshold of building nuclear weapons.

"The global community should anticipate a dramatic increase in state-sponsored nuclear proliferation activities, regardless of the fate of the JCPOA. Efforts to constrain such aspirations are critical. The net result of these events is that the world will soon face a greater proliferation danger from Iran and the spread of sensitive technologies in the Middle East may be stimulated by this new, dangerous norm legitimizing enrichment almost anywhere. The policy community must identify threats to the global export control regime and enact broader counterproliferation efforts to mitigate damages."

Export controls and broader counterproliferation efforts are indeed a must in the Middle East. But to date, all indications are that they will run a poor second to efforts to secure lucrative nuclear contracts.

Military conflict

Military conflict has been a recurring feature of Middle Eastern politics for decades and it isn't difficult to imagine military conflicts complicating and compromising nuclear power plants and associated facilities such as spent fuel stores. Since 2015, Saudi forces have intercepted missile attacks from Yemen on several occasions, including a missile attack on King Khalid International Airport in Riyadh in November 2017. "All airports, ports, border crossings and areas of any importance to Saudi Arabia and the UAE will be a direct target of our weapons, which is a legitimate right," the Houthi political office said in a statement on 7 November 2017.[57]

On 6 November 2017, the *New York Times* reported on the intercepted missile attack on the Riyadh airport: "Saudi Arabia charged Monday that a missile fired at its capital from Yemen over the weekend was an "act of war" by Iran, in the sharpest escalation in nearly three decades of mounting hostility between the two regional rivals. "We see this as an act of war," the Saudi foreign minister, Adel Jubair, said in an interview on CNN. "Iran cannot lob missiles at Saudi cities and towns and expect us not to take steps." ... The accusations raise the threat of a direct military clash between the two regional heavyweights at a time when they are already fighting proxy wars in Yemen and Syria, as well as battles for political power in Iraq and Lebanon. By the end of the day Monday, a Saudi minister was accusing Lebanon of declaring war against Saudi Arabia as well."[58]

Prince Turki al-Faisal said in 2016 that Saudi Arabia has "no illusions" about its limited nuclear security capabilities.

"We know we have few capabilities in terms of human resources, so that's why we began a very extensive training and skills acquisition program," he said.[15]

A number of Middle Eastern countries (and the US) have developed their own response to the limitations of the IAEA safeguards system: bombing nuclear facilities suspected of being involved in covert weapons programs. Examples include the destruction of research reactors in Iraq by Israel and the US; Iran's attempts to strike nuclear facilities in Iraq during the 1980−88 war (and *vice versa)*; Iraq's attempted strikes on Israel's nuclear facilities; and Israel's bombing of a suspected nuclear reactor site in Syria in 2007.

Most of the above-mentioned attacks were directed at research reactors capable of producing plutonium for weapons, while Iraq attacked the partially-built Bushehr nuclear power plant in Iran in 1987. Israel has threatened to strike nuclear facilities in Iran in recent years. According to a cable released by Wikileaks, King Abdullah urged the US in 2008 to launch military strikes on Iran's nuclear program to "cut off the head of the snake".[59]

In time, nuclear power plants in Saudi Arabia might be the targets of military strikes, either to prevent their use in a weapons program or simply as an act of war or terrorism.

Bennett Ramberg, a policy analyst in the US State Department's Bureau of Politico-Military Affairs under President George H.W. Bush, wrote in 2014:[60]

"[W]arfare is rife with accidents and human error, and such an event involving a nuclear plant could cause a meltdown. A loss of off-site power, for example, could be an issue of serious concern. Although nuclear plants are copious producers of electricity, they also require electrical power from other sources to operate. Without incoming energy, cooling pumps will cease functioning and the flow of water that carries heat away from the reactor core – required even when the reactor is in shutdown mode – will stop.

"To meet that risk, nuclear plants maintain large emergency diesel generators, which can operate for days – until their fuel runs out. The reactor meltdowns at Japan's Fukushima Daiichi power station in 2011 demonstrated what happens when primary and emergency operating power are cut.

"Such vulnerabilities raise troubling questions in the event of a war. Fighting could disrupt off-site power plants or transmission lines servicing the reactor, and could also prevent diesel fuel from reaching the plant to replenish standby generators. Operators could abandon their posts should violence encroach.

"Moreover, combatants could invade nuclear plants and threaten sabotage to release radioactive elements to intimidate their opponents. Others might take refuge there, creating a dangerous standoff. A failure of military command and control or the fog of war could bring plants under bombardment.

"Serious radiological contamination could result in each of these scenarios. And, though no one stands to gain from a radioactive release, if war breaks out, we must anticipate the unexpected. ...

"Wartime conditions would prevent emergency crews from getting to an affected plant to contain radiological releases should reactor containments fail. And, with government services shut down in the midst of fighting, civilians attempting to escape radioactive contamination would not know what to do or where to go to protect themselves."

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UK: Dodgy Decommissioning Deals

Author: Pete Roche – energy consultant and editor of NuClear News

NM854.4692 As *NuClear News* reported in April, the UK Government was forced to pay out £97 million in a settlement with two US companies – Energy Solutions and Bechtel – for mishandling the way it awarded the £6.1 billion Magnox nuclear decommissioning contract.[1]

The BBC's 'File on Four' has been delving in to some of the details of the contract, and what they have discovered suggests what went on was more than just "dramatic levels of incompetence", as the Labour Party called it, but was, in fact, a deliberate attempt to manipulate the outcome of the tender process.[2]

In 2012, the Nuclear Decommissioning Authority (NDA) put the second stage of the decommissioning process for the ten Magnox sites and two research reactor sites at Harwell and Winfrith out to tender. Up for grabs was a 14-year contract to take these sites to an Interim End State. The contract was expected to be worth £6-7 billion. Energy Solutions – the company which did the early decommissioning work at these sites – bid for the contract along with Bechtel. About £20 million was spent on putting the bid together with a team of up to 100 people working on it. The final bid included 750 pages of text; a cost estimate of up to 2,000 pages and 11,000 pages of supporting documents.

The bid was scored according to around 700 criteria. In the end the contract went to the Cavendish Fluor Partnership (CFP). But in September 2017, the NDA formally gave CFP two year's notice that the contract would end nine years early. It blamed a significant mismatch between the work outlined in the tender and what actually needed doing. BBC reporter Jane Deith continued: "But more serious than that – the NDA rigged the tender. It was only caught because Energy Solutions smelled a rat and took them to Court."

Ian Bowes, who was working for Energy Solutions until March 2016, told the BBC that the company identified a series of areas that technically they believed the NDA had got wrong in their evaluation. They also looked at the scoring of CFP and it seemed that Energy Solutions were not getting equal treatment. Documents from the NDA tracked how the scoring had been carried out. Someone had gone back into the computer and changed the scores initially awarded to the Energy Solutions bid.

A High Court Judge agreed with Energy Solutions. He said 22 of the scores awarded to Energy Solutions were wrong. Had the right scores been awarded the results of the competition would have been reversed. CFP should have been disqualified according to the technical criteria, and the NDA knew that. In the words of the Judge – Justice Peter Fraser – the NDA fudged it in order to keep CFP in the competition: "By the word fudging I mean choosing an outcome and then manipulating the evaluation to reach that outcome."

And, he said the NDA limited any permanent record of what it was up to, at one stage telling the evaluators to shred their notes. The NDA had acted unlawfully. It was forced to pay Energy Solutions and Bechtel £97 million. Adding other costs such as the £8.5 million cost of fighting the case in court, the total cost to the taxpayer is £122 million according to the National Audit Office.

The BBC asked the NDA why it manipulated the tender process. Was it because it was under pressure to select the cheapest bidder? If not, what was the reason? But it didn't get an answer. Chief Executive David Peatie, who arrived after the Magnox mess, apologised for past mistakes and said procedures have now changed.

Business Secretary Greg Clark has ordered an independent inquiry. Steve Holliday, former boss of the National Grid, is interviewing witnesses and will report next year. But the fallout could be huge because Ministers gave the whole Magnox contract approval. The NDA says the Government should take some share of the blame. Emeritus Professor of Energy Policy, Steve Thomas, says he thinks the NDA feels resentful that the Department of Energy (now the Department for Business Energy and Industrial Strategy – BEIS) has loaded the blame onto them rather than taking some responsibility themselves because the contract was approved by the Treasury and the Department of Energy and Climate Change, but only if it achieved savings of at least 10%. The bidding process and the overly complicated criteria were things they should have looked at.

The House of Commons Public Accounts Committee will look at this at the end of November 2017. Meg Hillier, chair of the committee, says the fiasco rings many alarm bells about how it could have happened with so many people in the NDA and Government looking into this contract. The Government says it monitors the NDA more closely now. The 10% saving target was meant to secure value for money and the right level of commercial expertise. In 2015, the Government cancelled a contract to clean up Sellafield saying it was too complicated for a private sector contract. It took back control of Sellafield and may do the same with the Magnox sites.

Cavendish is also decommissioning Dounreay as part of a consortium. It won the £1.5 billion contract in 2012, beating a bid by Energy Solutions and Amec. The BBC revealed that Energy Solutions believes that, just like with the Magnox contract, the scores for the Dounreay bid were "fudged". Energy Solutions didn't go to Court at the time because it didn't want to upset the NDA and ruin its chances of winning the Magnox contract.

People in the NDA confirmed to Energy Solutions that scores had been changed for the purpose of ensuring that it did not win the contract. The Magnox inquiry has spoken to witnesses about the Dounreay contract tendering process. If the inquiry seriously criticises the Dounreay contract, it would mean the NDA had mishandled three multi-billion contracts. The NDA didn't respond to allegations that scores for the Dounreay contract had been manipulated.

The NDA hasn't decided what to do about the Magnox contract, but the fiasco raises serious questions about the NDA's capability to handle the complex and dangerous job of safely taking apart ageing nuclear reactors. Steve Thomas says if the contract is to come back in house, the NDA would clearly need a major shake-up. One of the serious issues about long delays to decommissioning is that there are lots of things that can go seriously wrong. What's clear is that our atomic past will still be part of tomorrow's world.

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NUCLEAR NEWS

A dozen reasons for the economic failure of nuclear power

Mark Cooper, senior research fellow for economic analysis at the Institute for Energy and the Environment at Vermont Law School, has summarized nuclear power's economic problems in an article in the *Bulletin of the Atomic Scientists*.

He lists a dozen factors and trends that are currently making nuclear power uneconomic in the US (and of course many of these issues apply elsewhere):

Supply-side factors:

1. Nuclear construction costs are escalating, driven by the complexity and demanding nature of the technology. This is especially true for a reactor design that is not yet operational; the first AP1000 will not go online until late this year or early next year, in China.
2. Low prices make natural gas more economically competitive than other forms of baseload power, namely nuclear and coal.
3. Alternatives such as wind and solar power are declining in cost, thanks to technological improvements that have cut costs by 50–75% in a decade or two.

Demand-side factors:

4. Because of increasing efficiency, US demand for electricity is not growing as quickly as in the past.
5. Individuals and communities are increasingly able to supply their own energy with solar panels and batteries.

System integration factors:

6. Utilities have an increasing ability to manage and integrate demand and supply, due to advances in communications and advanced control technologies, which allows them to reliably generate an adequate amount of electricity even with a reduced reliance on baseload power.
7. Integrating, coordinating, and managing supply and demand transforms the nature of the grid and allows a reduction in total system size of 15–20%. For example, a 2016 paper published by Jim Lazar, a senior adviser at the Regulatory Assistance Project, found that adding renewable energy resources – while also implementing strategies to reduce peak electricity demand, and to deliver more output during afternoon high-load hours – could increase the load factor for a typical southern California utility from 73.6% to 86.5%, an improvement equivalent to 17.5% of the original load factor.
8. Energy storage, an area that had been largely neglected, is experiencing rapid growth. Batteries powered by renewable energy sources now offer an affordable way to provide electricity during hours of peak demand.

Reactors do not age gracefully:

9. Aging reactors can no longer cover their costs in the new environment, because they need increasing maintenance, repair, and replacement of parts as they age. This is particularly challenging because of the complexity of the technology, and the availability of newer, lower-cost alternatives that are driving down prices in states with deregulated electricity markets.
10. Bad management causes the abandonment of aging reactors. In fact, several recent early retirements of reactors – at the San Onofre and Crystal River nuclear plants – were caused by botched efforts to repair reactors. This problem has plagued the industry throughout its existence.
11. Demands for subsidies throughout the nuclear lifecycle are a reminder of nuclear energy's inability to compete in a free market, and a focal point of current political struggles at the federal and state levels. Current subsidies are insufficient to make nuclear power, old or new, economically competitive in deregulated electricity markets. Energy Secretary Rick Perry recently asked the Federal Energy Regulatory Commission to change electricity pricing to boost compensation for nuclear and coal plants. Perry also recently announced that the Energy Department would provide $3.7 billion in loan guarantees (in addition to $8.3 billion granted earlier) to support ongoing construction of the two AP1000 reactors at the Vogtle nuclear plant in Georgia.
12. Difficult, expensive, and lengthy cleanups after accidents – such as the meltdowns at the Fukushima nuclear plant in Japan – continue to remind people that nuclear technology can be very dangerous.

Mark Cooper, 17 Oct 2017, 'A dozen reasons for the economic failure of nuclear power', Bulletin of the Atomic Scientists, https://thebulletin.org/dozen-reasons-economic-failure-nuclear-power11196

India: Former chair of regulatory board calls for freeze to nuclear power program

Dr. A. Gopalakrishnan, a former Chair of India's Atomic Energy Regulatory Board, has written a 2500-word article calling for the country's nuclear power program to be suspended and re-evaluated. He notes that his views are based on many decades of experience and his intimate understanding of and participation in the Indian nuclear program.

He writes: "An overall evaluation of the status of the Indian civilian nuclear power sector, and the government's uncertain future plans, do cause a great deal of concern for the welfare of the country and the safety of our people. Therefore, it is best to freeze all plans for the further expansion of this sector until Parliament and the public are provided full details of the government's intentions and rationale and a national consensus is reached."

Dr. Gopalakrishnan criticizes the top-heavy mismanagement of the nuclear program: "The Indian civilian nuclear power program is ultimately administered by the Department of Atomic Energy (DAE) which reports to the Prime Minister. The detailed policies, programs, and projects of both the civilian and military aspects of atomic energy are overseen and approved by a supra-powerful body called the Atomic Energy Commission (AEC). ... Once this group approves a program or gives a decision, no other entity like the Comptroller & Auditor General (CAG), who should be overseeing financial propriety in the Central Government expenditure or the Atomic Energy Regulatory Board (AERB) which is responsible for project & public safety, will usually dare to question the AEC decision. This top-heavy administration of the nuclear program and the fear that it exudes is at the heart of most of the ailments of the nuclear sector."

He raises concerns about the existing fleet of reactors: "Of the operating reactors, some are very old and partially disabled and others are of dangerously outdated design which DAE is continuing to operate, though recommended by the original supplier to be permanently closed down."

The Indian government claims that its decision to build more pressurized heavy water reactors (PHWR) "will be a major step toward strengthening India's credentials as a major nuclear manufacturing powerhouse". Dr. Gopalakrishnan responds: "But, with the whole world receding from setting up nuclear plants, by the time this "major powerhouse" is established in 4-6 years, where are the foreign orders for nuclear plant components going to come from? Or, are we planning to use tax-payers' money to continually prop up the ailing big manufacturing industries in India by giving them nuclear power orders, whether we want nuclear power or not?"

Dr. Gopalakrishnan questions safety standards and the adequacy of nuclear regulation: "The state of nuclear reactor safety in India today is suboptimal to say the least. The agency which should be overseeing nuclear safety in India, the Atomic Energy Regulatory Board (AERB), has no standing as an independent entity, no direct access to the AEC or to any of the Parliamentary committees. The Chairman of the AERB reports to the AEC Chairman, whose instructions finally dictate the AERB's actions. In contrast, the French nuclear regulatory body (the ASN) is created under a separate Act of the French Parliament and is answerable only to their Parliament. To summarise the state of nuclear safety in India and suggest possible corrective actions, an article in a journal will not suffice, it will require one whole book to be devoted to it."

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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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