# A Nuclear Materials Authority

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**SUMMARY**

The Nuclear Decommissioning Authority (NDA) has produced a Final Report on options for handling of UK Stocks of Uranium and Plutonium which is a reprise of a long standing view that the UK should not pursue any new nuclear build. This view is being swiftly abandoned in the USA by federal and state governments as they prepare for a major new nuclear build. The Report is, of course, part of the positioning of the NDA itself for a speedy sale into commercial ownership and so is hardly an unbiased view.

The option to bury all the stocks as waste is described as 'low risk … and the lowest cost option.' This is in fact the very worst option, denying use of all this fuel to ourselves and others. The option to place all the materials in long term Storage 'on the assumption that they **may** have a value in future' flatly ignores all the current successes in new nuclear technologies, the surge in Uranium exploration, and the plans for large nuclear programmes in the USA, China, India, and Japan. The 'Use it Now' option, as described, is quite premature as the only fissile materials are 100 tonnes of Plutonium and the small amounts of U-235 remaining in the Depleted Uranium. The NDA correctly calculates that this is only sufficient to run three or four PWRs for 60 years, and leaves the impression that the Stocks are indeed of little value. However, the Plutonium stock alone is sufficient to start 20 Fast Reactors which would then be self fuelling from DU stocks for hundreds of years. The Report dismisses such developments as having 'significant downside risks' and limits the Use models to 12 PWRs and 12 Fast Reactors, only 30% of UK electricity needs. Knowledgeable buyers of the NDA will know that the sale includes ownership of this vastly undervalued asset.

The commercial spin and underlying anti-nuclear agenda in this Final Report make the case for the NDA to be taken over **now** by a new body, the Nuclear Materials Authority, which will pursue the very opposite of all their suggestions to instead extract the real value of these fuel stocks. This is the beginning of a thousand year nuclear energy system.

The starting point is to build a safe and highly secure storage system for all nuclear materials. Store for Use is much more demanding than anticipated by the NDA. All material must be assayed, tagged, and continuously monitored for decay, leakage, water incursion, and other hazards of long term storage. Radioactive materials must be stored by a fully robotic, self repairing (without human entry), deposit and withdrawal system from transport caskets which dock with storage facilities, fuel processing, and reactor plants, just like a space station supply system. This will be an integrated Enclosed Radioactive Materials System (ERMS) and once in the system, materials never leave it. A prime example of such technology is the robotic repair and maintenance system for the JET Fusion Reactor at Culham.

Imported Uranium ores and depleted natural Uranium are lightly radioactive and may be assayed, stored and monitored more simply as a reactor fuel feedstock inventory. Meticulous, automated accounting for all materials is still required for these materials.

At least three reactor types will be used this century: (1) PWR workhorse using mined Uranium and recovered Plutonium in MOX fuels. These will double our stocks of Uranium and Plutonium by 2050. (2) High Temperature, Deep Burn thermal reactors using TRISO million year fuel (GT-MHRs) to dispose of new and legacy PWR reactor waste. The packaging of fuel particles in tiny Silicon Carbide coated spheres allows for 10 times the burn up of a PWR and thus the complete burn of the long lived actinides. These are ready for final demonstration, well ahead of the Fast Reactors. (3) Fast Breeders, like the General Electric S-PRISM, able to self fuel with the Plutonium they breed from Depleted Uranium feedstocks. They may use metallic fuels and their fast neutrons will also burn all higher actinides. Another important competitor on this time scale is the Molten Salt Thorium ~~Breeder~~ Reactor which opens up another huge fuel supply. [[[[[[To be a breeder required removal of Pa233 and let it decay to U-233 outside the neutron flux to avoid its capturing neutrons to form Pa234, decaying to U234. This step has been highlighted as being too dangerous a proliferant route by criticas. The alaternatiave is to increase the core size thus lowering the neutron flux so much that the capture in Pa233 is small compared to its decay to U233. This version can be a Conversion ratio equal unity reactor. IF we have some fuel supply such as a fusion breeder then a conversion ratio of unity is good enough. So this is the reason I suggest changing th word above from Breeder to Reactor.]]]]] All reactors should be designed for easy robotic decommissioning, with all waste components entering the ERMS for storage and ultimate recovery, or for disposal.

So, our third generation fuel factories will end up producing three different fuel types. These fuel factories will be a part of the Enclosed Radioactive Materials System and optimised for efficiency, ease of robotic maintenance, totally monitored safety, and will not generate even low level waste outside the closed system. The modular designs will also minimise the internal creation of Intermediate Level Waste so valuable materials can be separated from linings and components contaminated by traces of Plutonium and other radionuclides. They will also be designed for automated disassembly and refurbishment at the end of their service life, with waste material remaining in the ERMS. Well designed fuel factories could continue in production for 1000 years.

Automated Reprocessing plants are an essential part of the fuelling system. Spent Fuel from reactors will go through the same, new, UREX separation process which produces three steams of materials: (1) All the 80-95% of Uranium isotopes together. ). (2) All the 2-5% Plutonium and higher actinides like Neptunium and Americium. (3) The 5% of High Level Waste of radioactive fission products (HLW) with a half life of 100-300 years. [[[[[[[[The story is a bit more complicated by the long lived fission products such as Tc-99, 210,000 y,, Çs—135,2.3 million y, I-129, 1.6 million y .]]]]]] . It is not necessary to refine the isotopic mix of the two fuel streams for the advanced reactors, but for the PWRs the recycling is only good once without refinement. This is a good reason not to waste our Plutonium stocks in PWRs, but save them to start the Breeder fleet. The plants will have to process some 40 tonnes of Spent Fuel per reactor year.

Over the centuries, all the Uranium entering the system leaves as HLW as it is burned, at the rate of 1 tonne per reactor year. The material is hot, but will contain virtually no fissile material, and is still a useful source of energy, at least for powering embedded monitoring and warnings systems with each package going to geological disposal. [[[[[[A good separation technology might have a separation of 99.8 to 99.9%. This leaves a carry over of 0.1 to 0.2% fissile. ]]]]]]]] This material must be assayed, tagged, and monitored just like every other gram of materials in the ERMS.

Without further discussion here, it is apparent that the ERMS will provide very tight control of all nuclear materials in the civilian nuclear energy programme. It accounts for them on grounds of commercial value, safety, and long term security. More importantly, the ERMS cuts off civilian nuclear technology from military uses and will make a major contribution to the problems of weapons proliferation. The technologies are destined to have a huge global market, but this must be tightly regulated to preclude any of the many proliferation possibilities. The current marketing free-for-all would not be permitted and no private company would actually ‘own’ any nuclear materials.

The big prize for developing and building all this technology is a reliable, carbon free source of energy to run our homes, offices, factories, and electric transport systems for 1000 years. We would actually own all the necessary fuel and have it in stock. Our energy security will be independent of the vagaries of markets for centuries. There is enough Uranium for most of the world to achieve the same level of energy security, but the Uranium market is about to rise hugely, especially now that the International Energy Agency (IEA) has admitted that Oil supplies will peak and decline within five years. It would now be to our advantage to buy all the stocks of Uranium, Plutonium, and Spent Fuel that Germany and Sweden view as waste and place them in our fuel vaults.

Clearly this all needs a large investment in engineering, chemistry, nuclear physics, robotics, surveillance and stock management, and long life engineering design of efficient radioactive materials plants. The UK no longer has the technical or scientific capacity to do any of these things. However, the timescales and needs are such that this capacity can be rebuilt to our economic and commercial benefit. The US and China are setting about a major nuclear programme with a value of at least $300 billion, but last year we sold our stake in Westinghouse Nuclear, holders of the first NRC Licensed reactor design for the USA, for a paltry £5Bn. To sell the NDA and its fuel stocks would be a colossal fiscal blunder.

The system modelling of the Store for Use by the NDA is based, not on the energy value of the materials but on a flawed view of Uranium prices over the next 300 years. As coal and gas are cut back to evade climate change, and oil supplies decline, the Uranium market will change dramatically within decades. Here we propose to measure the value by the price we are willing to pay for a kilowatt-hour, about 10p at present. All our nuclear materials now in stock can deliver a stunning £876M per tonne for energy sold.

This sets out the case to replace the NDA with a Nuclear Materials Authority, commissioned to develop and deploy the nuclear energy systems outlined here, turning away from costly disposal systems to a range of highly valuable and profitable enterprises. A Full Report is available from the author.

**Author**

Brendan McNamara worked on Fusion Theory and Computations with AEA Technology, Culham (1961-71) and at the Lawrence Livermore National Labs in California (1971-85). He also ran a series of Plasma Colleges at ICTP, Trieste, 1974-84. He was V.P. of a Supercomputer Center in Princeton (1985-88) and now operates Leabrook Computing as a Consultancy.

Lectures on ‘Futures for Nuclear Energy’, ‘Carbon Free Electricity’, Nuclear Energy & Weapons Proliferation’ have so far been given at Livermore , General Atomics, AEA Technology Culham Laboratory, MIT, the UK Defence Academy, and others.

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