

Written evidence submitted to the Public Accounts Committee inquiry into Decommissioning Sellafield (DS0005)

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Executive summary:

- Sellafield contains high levels of irradiated waste that, if left untreated, will take tens of thousands of years to reach a stable state that would pose a minimum threat to mankind. Over the years due to degradation of the storage facilities, some of the water has leaked from the storage ponds into the surrounding areas. There is also the issue of what to do with the spent fuel that is currently either encased in canisters in the ground within the facility itself or within the storage ponds located on site, with the main current option being to break it down into smaller pieces for encasing in concrete for further burial elsewhere.
- The site is facing numerous decommissioning issues that are resulting in costs being far greater than originally estimated. As identified by the committee, most major projects there have been significantly delayed, with expected combined cost overruns of £913m in 2018.
- Whilst there is the solution of breaking down the material into smaller sections for further storage, other options should be explored such as further re-processing where possible and use of microbial and fungal solutions that are capable of 'eating' and absorbing radiation thus making the spent fuel and irradiated materials manageable again.

Written evidence:

1. The storage of nuclear waste at Sellafield is currently posing an issue to the decommissioning of the site. At this present time, the main solution of disposal is to seal the waste into thick concrete and metal containers then placed in vaults or deep underground tunnels. As time progresses, and the amount of waste increases, this is becoming more unfeasible and a new way of disposing of nuclear waste should be sought.
2. There are currently five practical and one theoretical way that nuclear waste could be disposed of. The practical methods are retaining in sealed containers within the facility, retaining in ponds, breaking down into smaller pieces for burial in concrete, natural degradation and further processing. The theoretical way of dealing with the waste is that of bacterial and fungal breakdown. The first four solutions remain unviable and unsustainable as it means future generations will still need to deal with the aftermath of waste generation.
3. The first practical method of disposal, sealed containers, continues to be unviable due to not only not dealing with the waste, so it is no longer hazardous, but also being a very costly solution. Not only do canisters need to be sourced to contain the waste, but they also need continuous monitoring and maintenance, with eventual replacement at signs of degradation. There is also the issue of costly disposal of used containers, usually either stored in ponds or buried in concrete along with spent fuel rods. There is also additional cost of personnel and machinery to handle the canisters.

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4. Retention in ponds, being the second practical solution, is also unviable as this ultimately results in irradiated water over a long period of time. This results in high costs from having to drain down contaminated water for further storage as well as re-filling the ponds with fresh treated water. Additionally, there is further concern that the ponds are not being maintained as well as they should be, resulting in leakages into the surrounding environment from container erosion.
5. Breaking the waste down into smaller pieces as another practical option, whilst aiding in the disposal process to some extent to allow further processing, these pieces would still need to be sealed in concrete then buried either in ponds or deep underground. Again, another unfeasible option for the disposal of Sellafield waste due to leaving the waste for future generations to deal with.
6. Natural degradation is the fifth practical option that could be explored further, though may arguably be the solution to take the longest. Over two billion years ago, the planet had its own natural nuclear reactor because of planetary activity following astral objects bombarding it. Over time, the naturally occurring uranium-235 (U-235) has degraded to a level like that of U-238 that has gone through the fission process. However, as this has taken just over 2 billion years, allowing natural degradation is also an unfeasible solution to the issue of waste (Gil, 2018). The Chernobyl facility in Ukraine may be the best example of this following encasing it in a sarcophagus due to the hazardous nature of the exposed reactor.
7. Further processing as a final practical solution may aid in the decommissioning process to turn the waste into more useful solutions for use elsewhere. Whilst the nuclear fuel may not be suitable for re-use in other power plants or military use, there may be some viability to using it in other areas such as nuclear medicine. This could potentially be achieved via the same way the fuel ore is processed, i.e., using acid to strip the fuel from other minerals it is combined with.
8. Microbial breakdown, albeit currently theoretical is a final option for Sellafield decommissioning. There are certain bacteria and fungi that are able to deal with irradiated materials, such as *deinococcus radiodurans* which is capable of tolerating high levels of ionizing radiation and UVR. It can also be genetically engineered to consume and digest heavy metals and solvents in radioactive environments. Another bacterium is *geobacter* which uses molecules called lipopolysaccharides to soak up uranium.
9. Scientists working at the Chernobyl Nuclear Facility in Ukraine have also discovered a fungus growing within the damaged reactor that is resistant to the effects of radiation. The fungus found at Chernobyl, identified as *Cladosporium sphaerospermum*, converts the radiation into energy via the process of radiosynthesis, using melanin to convert gamma radiation into energy. The fungus has been so effective at shielding radiation that astrophysicists at NASA have undertaken studies to view the potential benefits of using the fungus to shield astronauts from radiation. As research is still ongoing for this, like the microbial solution, this can be classed as theoretical.
10. Overall, it is recommended that the committee review and research into the use of bacterial and fungal solutions to aid in the decommissioning of Sellafield, as although the initial research and development may have a small cost impact, the overall benefit would far outweigh this impact due to the residual waste being broken down into far less toxic materials, making them far safer for storage and, if radiation doses are

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lowered enough, potentially even result in the materials being able to be used elsewhere.

References

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