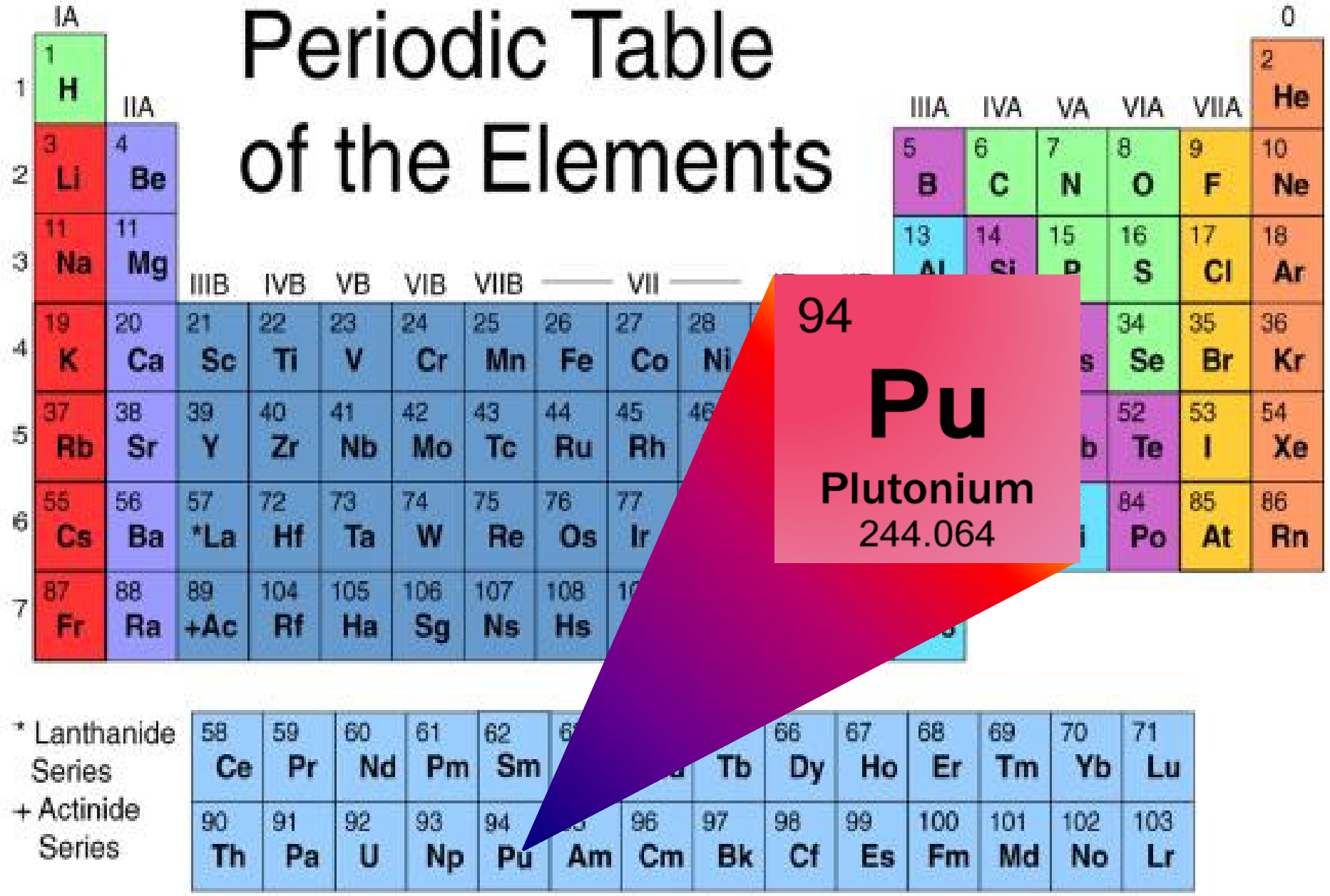
Plutonium Management & Disposition Programme – Progress update- July 2014

Nuclear Decommissioning Authority


Periodic Table of the Elements
IA
IIA
IIIB
IVB
VB
VIB
VIIB
VII
IIIA
IVA
VA
VIA
VIIA
0
94
Pu
Plutonium
244.064
* Lanthanide Series
+ Actinide Series

Reprocessing

- **Large scale reprocessing undertaken in UK for over 50 years**

- **Magnox reprocessing**
  - Commenced 1950s and due to conclude around 2020
  - Circa 55000 tonnes of fuel reprocessed at end of programme
  - Largely UK material although processed some Tokai Mura fuel

- **Oxide fuel**
  - Windscale Inquiry (Mr Justice Parker 1978)
  - Fast Reactor Programme at Dounreay ceased 1994
  - THORP commenced 1994 and due to conclude around 2018
  - Circa 10000 tonnes of fuel reprocessed at end of programme
  - Around half of the material is UK AGR fuel, with the remainder composed of overseas fuel

Pu holdings and material types

- **Current holdings of civil plutonium are c. 120 tHM**
- **After completion of existing reprocessing contracts, holdings will have risen to c. 140 tHM**
  - ~120 tHM UK owned
  - ~ 20 tHM overseas owned, predominantly Japanese
- **Material produced over many decades from a range of spent fuel types in a range of facilities**
  - Majority of material is well characterised good quality PuO2
  - Some material not well characterised but likely good quality
  - A portion of the material is contaminated PuO2 with eg Cl
  - Smaller quantities of plutonium contained in eg MOX scraps and residues

Current strategy – long term secure storage

- Current strategy being implemented is long term safe and secure storage of separated civil plutonium
- This will see consolidation of UK stocks at Sellafield, following the planned transfer of material at Dounreay to the site, simplifying and enhancing security overall.
- This strategy requires a number of expensive modern state of the art facilities to be constructed as the existing stores reach the end of the design lives, and will ultimately result in a single store complex, Sellafield Product and Residue Store (SPRS), required to operate until post 2100 containing the stockpile.
- Ongoing implementation requires continuous active management and significant security resource, both in terms of facilities and personnel
- Continued long term storage of plutonium is not a complete lifecycle option

Plutonium Policy development – 2011 consultation outcome

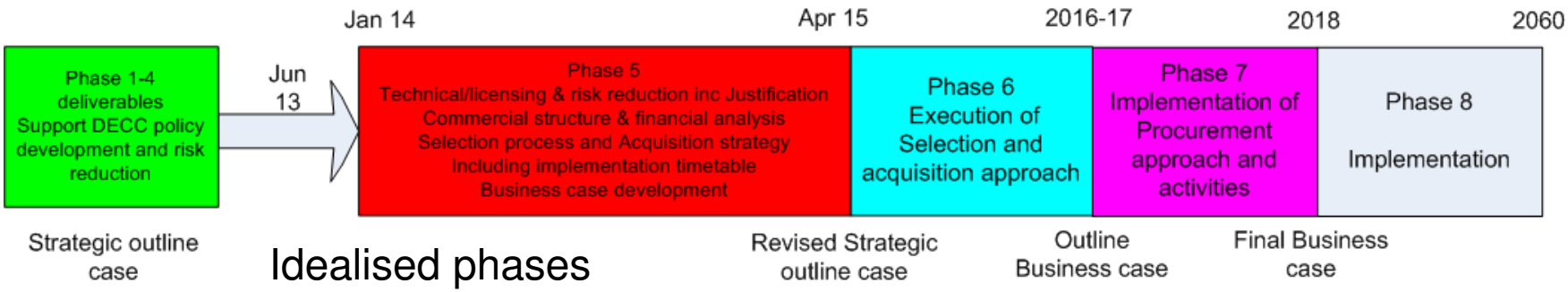
- The government proposed a preliminary policy view to pursue **reuse of plutonium as Mixed Oxide fuel**, converting the vast majority of the UK civil separated Pu into fuel for use in civil nuclear reactors.
- Any remaining Pu whose condition is such that it cannot be converted into MOX will be immobilised and treated as waste for disposal.
- In addition government concluded that **overseas Pu in the UK could be managed alongside UK Pu, or title could be transferred to the UK**, subject to acceptable commercial terms.
- Government also pointed out that they were open to **alternative proposals for Pu management** if they offered better value for money to the taxpayer and would seek to gather more information on all options:
  - General Electric-Hitachi PRISM
  - CANDU EC6

Programme Description

The aim of the programme is: **to plan, develop and implement a management solution for the separated civil plutonium in the UK through reuse, immobilisation and disposal until the stockpile has been reduced to zero and is put beyond reach.**

- Plutonium has arisen from large scale reprocessing undertaken in UK
- After completion of existing reprocessing contracts, holdings will have risen to circa 140 tHM (~120 tHM UK owned ,~ 20 tHM overseas owned)
- Material produced from a range of spent fuel types in a range of facilities
- Current strategy being implemented is long term safe and secure storage including consolidation of stocks at Sellafield
- Continued long term storage of plutonium is expensive, politically unacceptable and not a complete lifecycle option

NDA role and programme approach



- **NDA supporting DECC in its policy development and delivering the programme on its behalf.**
- **The recent phase of the programme has targeted key areas of technical and commercial risk and uncertainty, and considered the preferred option alongside credible alternative proposals.**
- **Advice provided to DECC in Summer 2013 and, after consideration by cross- Whitehall representatives, Phase 5 is being implemented.**

Phase 4 conclusions

- Recent work undertaken by NDA considered a review of the reuse as MOX option and developed positions on the alternative reuse proposals (in CANDU or PRISM reactors)
- NDA concluded that reuse remains the preferred option and, there are three credible reuse options: - as MOX in light water reactors (reference option), in CANDU EC6 reactors and in PRISM fast reactors.
- There is currently insufficient understanding to confidently move into implementation and significant further work must be undertaken to enable DECC and UK Government to ultimately select and subsequently implement its preferred reuse option.
- All options require further understanding of technical aspects, including licensing, to be developed.
- Technology vendors are leading the proposals and commercially, there are many ways to implement them.
- Three distinct technical solutions are being proposed so the plan is to use a competitive process to secure the best outcome although NDA will establish approaches to cover both a competitive and sole provider market condition until market positions are better understood
- The exact timing of decision making will be established once the above work has progressed sufficiently.

Thermal MOX in UK LWR

- Reuse as MOX Reuse included in 2011 NDA credible options paper.
- Implementation requires a complex and expensive fuel fabrication facility as well as suitable reactors, such as EPR, ABWR, AP1000 etc, able and willing to use the fuel.
- Reuse as MOX is the most technically mature option available although risks remain with its timely implementation, based on market readiness, offtake capacity and utility appetite, cost uncertainty and the amount of material that can be readily reused.
- Converts the plutonium into a form that is self-protecting and familiar prior to it being disposed of in a GDF as spent fuel
- Used as reference reuse option.

Alternative Proposals – GEH PRISM

- Fast reactors **not** included in 2011 NDA credible options paper
- Implementation requires a complex and expensive fuel fabrication facility (although claimed by GEH to be simpler/cheaper than an LWR MOX plant) as well as integrated reactors to use the fuel.
- Converts the plutonium into a form that is self-protecting prior to it being disposed of in a GDF as metallic spent fuel
- Studies undertaken with GEH
  - Licensability of PRISM and associated facilities and technical underpinning
  - Disposability of spent PRISM fuel
  - Commercial viability and market interest in PRISM for Pu
- Deliverables received in 2012 and NDA concluded, that on the information provided, PRISM should be considered a credible option
- Key risks remain regarding technical maturity, implementation timetable, cost uncertainty and the commercial implementation option.

Alternative Proposals – CANDU

- CANDU technology included in 2011 NDA credible options paper
- Implementation requires a complex and expensive fuel fabrication (although claimed by Candu to be simpler/cheaper than an LWR MOX plant) facility as well as dedicated reactors to use the fuel.
- Converts the plutonium into a form that is self-protecting prior to it being disposed of in a GDF as CANMOX spent fuel
- Studies undertaken with Candu
  - Commercial viability and market interest in CANDU for Pu
  - Refinement of previous technical work including licensability
  - Disposability of spent CANDU fuel
- Deliverables received in 2013 and NDA concluded, that on the information provided, CANMOX should be considered a credible option
- Key risks remain regarding technical maturity, implementation and deployment plan, cost uncertainty and commercial implementation option and the amount of material that can be readily reused.

Phase 5 work scope
Output is revised Strategic Outline case

Technical

- Improve understanding of the technical aspects of each credible reuse option to establish the licensability of the lifecycle solution;
- Further underpin the costs and revenues of each credible reuse option including contingencies, risks and uncertainties;
- Further develop understanding of all primary options, including continued storage and immobilisation

Commercial

- Obtain an in depth understanding of the potential commercial structures by which the options could be financed and delivered through active market engagement with suppliers of technology, equity or funding;
- Develop a view on the level of direct or indirect support government could give to secure a reuse solution and the mechanisms by which this could be realised

Phase 5 work scope -2
Output is revised Strategic Outline case

Acquisition/procurement

- Gain a full appreciation of the options available to select and acquire the solution based on the market conditions and an understanding of the means by which this process and a subsequent procurement would be run

Implementation

- Develop the schedule and likely costs of implementation, to enable timely inclusion into NDA and government spending rounds

Overall Programme Status

- **Progressing the next phase**
- **Phase 5 anticipated to run for 12 -18 months**
- **Phase 5 commenced covering**
  - Technical
    - Significant engagement with consortia
  - Commercial
    - Develop detailed proposals with consortia
    - Understand acquisition strategies
  - Implementation
    - Decision making process and criteria
    - Funding and Comprehensive Spending Review processes