Plutonium and Aldermaston - an historical account

SUMMARY

The Government set in hand in the Strategic Defence Review (SDR) a process of declassification and historical accounting with the aim of producing, by the Spring of 2000, an initial report of defence fissile material production since the start of the United Kingdom's defence nuclear programme in the 1940s. This report is the first part of this study and deals with plutonium. The scope of this initial review, in line with Government initiatives on openness, provides information on the movement of plutonium to and from the Atomic Weapons Establishment (AWE) Aldermaston where all fissile components for nuclear warheads have been manufactured.

This work complements the SDR announcement of the current stock of nuclear material, held outside international safeguards, for national security purposes. The SDR also announced that surplus stock would be placed under Euratom safeguards and made liable to inspection under the terms of the safeguards agreement between the UK, Euratom and the IAEA. The plutonium stored at Sellafield has now been placed under safeguards and the process of transferring the 0.3t of surplus weapons grade plutonium from Aldermaston to a civil nuclear site, and bringing into safeguards, has commenced.

Records were raised each time material was moved between sites. The review was therefore conducted primarily from an audit of annual accounts and delivery records from Sellafield supported by receipt records at Aldermaston where these are available. Evidence was also sought from available secondary sources. Records for the early years are inevitably less complete and less detailed than for more recent years, although Sellafield has maintained good accounts throughout, which cover the great bulk of material transferred. Overall, confidence in the completeness and accuracy of the information available is very high for the 1980s and 1990s, but less so before the mid 1960s.

The review concludes that Aldermaston acquired 16.83 tonnes of plutonium from the start of the programme until 31 March 1999, the baseline date for this report. Records suggest that during this period 13.61 tonnes of plutonium were removed from Aldermaston. However, there were definitely still 3.51 tonnes in the defence nuclear stockpile on 31 March 1999. The sum of the recorded removals from Aldermaston and of the audited stockpile (17.12 tonnes) is therefore 0.29 tonne higher than the recorded total of plutonium acquired by Aldermaston (16.83 tonnes). This 0.29 tonne excess of stockpile over what records suggest it should be represents some 1.7% of recorded acquisitions. However, this is regarded as a reasonable outcome given the long period covered and the limited availability of records for the early

years.

SECTION 1: INTRODUCTION

1. Since the end of the Cold War there has been a re-examination of many of the capabilities required to meet our minimum nuclear deterrence needs. Information relating to our nuclear stockpile has historically been closely protected to ensure uncertainty in the minds of others over just what our capabilities were. It was concluded in the Strategic Defence Review (SDR), in July 1998, that we could safely make significant reductions in planned warhead numbers and changes to the operational posture of the nuclear deterrent as a result of the improved strategic circumstances. Transparency about nuclear weapons holdings also plays a significant role in arms control and adds to international confidence. It was also stated in the SDR that the UK intends to be significantly more open about stocks of fissile material, as part of the confidence building measures required to support long term nuclear weapon arms control and warhead reduction initiatives.

2. One study initiated under the SDR was; *a process of declassification and accounting with the aim of producing by Spring 2000 an initial report of defence fissile material production since the start of Britain's defence nuclear programme in the 1940s*. This report is the first part of this study and deals with plutonium. The scope of this initial review, in line with Government initiatives on openness, provides information on the movement of plutonium to and from the Atomic Weapons Establishment (AWE) Aldermaston where all fissile components for nuclear warheads have been manufactured. Examination of reactor discharge records and subsequent tracking of material through fuel reprocessing are not included. There was no requirement to create consolidated records that would allow this path to be followed easily. Records for individual reactor discharges would need to be located and compiled. Some of these records were observed but there is no way of knowing without an exhaustive search whether all are available. In any event, to follow this process with the required degree of accuracy it would be necessary to know what went into and out of the reprocessing facilities at a level of detail that the available records, even if complete, do not provide. Ownership of plutonium stocks is allocated to BNFL customers on the amount of fuel reprocessed over a given financial year.

3. This work complements the SDR announcement of the current stock of nuclear material, held outside international safeguards, for national security purposes. The SDR also announced that surplus stock would be placed under Euratom safeguards and made liable to inspection under the terms of the safeguards agreement between the UK, Euratom and the International Atomic Energy Agency (IAEA). The plutonium stored at Sellafield has now been placed under safeguards and the process of transferring the 0.3t of surplus weapons grade plutonium from Aldermaston to a civil nuclear site, and bringing into safeguards, has commenced.

SECTION 2: BACKGROUND

Management of UK Nuclear Industry

4. The UK nuclear weapons programme was formally initiated in January 1947. The military and civil nuclear cycles have been run in parallel and to some extent were entwined during the early years of the nuclear programme. The Ministry of Supply was the lead organisation until the United Kingdom Atomic Energy Authority (UKAEA) was formed in 1954. The great part of the UKAEA's activity at that time was research, development and production in the civil and military fields.

5. The UKAEA managed a broad range of nuclear facilities in the early years and was managed as four Groups; Production, Reactor, Research and Weapons before the next major change came. In 1971 British Nuclear Fuels Ltd (BNFL) was established from the production activities of the UKAEA. BNFL took over the major share of the assets. The BNFL portion of the Windscale site was renamed Sellafield in 1981 to distinguish it from the remaining UKAEA activities on the same site. (The name Sellafield will be used in this report, for clarity, to refer to the site where plutonium originated, even for the early years).

6. The UKAEA organisation that remained after 1971, excluding the Weapons Group, was primarily research and development (R&D) based with major facilities concentrated at Dounreay for Fast Breeder reactor development, Winfrith for other reactor development, Windscale for reactor development, fuel production and examination and Harwell. In 1989, after reorganisation into businesses, the UKAEA started to use the trading name AEA Technology. Further changes in the organisation subsequently took place enabling privatisation, as AEA Technology, of the contract research part of the UKAEA. The remaining UKAEA organisation is a non-departmental public body, reporting to the Government through the

Department of Trade and Industry. It is concerned mainly with carrying out the decommissioning and waste management responsibilities from the past nuclear research and development programme and for the fusion research programme.

7. In 1950 nuclear weapons design work moved from Fort Halstead to the Atomic Weapons Research Establishment (AWRE) at Aldermaston. AWRE, with the trials range at Foulness in Essex, made up the UKAEA Weapons Group which transferred to MOD ownership in 1973. In 1987 AWRE was renamed the Atomic Weapons Establishment (AWE), on incorporation of two of the former Royal Ordnance Factories at Burghfield and Cardiff, to reflect the integration of all aspects of the nuclear weapons production programme under one management control. (The name Aldermaston will be used in this report for clarity). AWE then comprised four sites:

- Aldermaston – weapons related R&D, fissile material storage and recycle, and component manufacture
- Burghfield – weapon assembly and breakdown, and non-fissile component manufacture
- Cardiff – depleted uranium and beryllium component manufacture
- Foulness – non-nuclear trials in support of the nuclear weapons programme.

Management arrangements at the site were radically changed in 1993 when legislation was put in place creating AWE as a Government Owned Contractor Operated (GOCO) site and the Hunting BRAE consortium became the management contractor. Following a rationalisation initiative, the Cardiff site has been closed and Foulness transferred to the Defence Evaluation and Research Agency (DERA). A further competition for the management contract has seen AWE Management Limited take over as the management contractor from April 2000.

8. The wide-ranging nature of the early UKAEA organisation meant that some blurring of the distinctions between the military and civil roles of the establishments was inevitable. The mixing of military and civil programmes was not seen as significant at the time, in the context of one integrated organisation, and the weapons fabrication facility also carried out development work in support of the civil industry.

UK Fissile Material Facilities

9. Annex 1 lists the major facilities in the UK nuclear industry that are discussed in this report.

10. Work commenced on the Windscale Piles in Cumbria in 1947 and plutonium for the early nuclear weapons programme was produced until the fire in Pile 1 in 1957. A reprocessing facility was constructed for the separation of plutonium and uranium from spent fuel, and later replaced with another plant as the Magnox programme grew. Even at this early stage some plutonium was sent to Harwell, via Aldermaston, for research on civil applications of nuclear power. The Calder Hall Magnox power station, constructed on the Sellafield site, started operations in 1956 and consisted of four dual-purpose reactors for commercial electricity generation and plutonium production for defence needs. The Chapelcross power station in Southern Scotland started operations in 1958 and was operated on the same basis as Calder Hall. These two stations (8 reactors in all) were owned and operated by UKAEA and subsequently transferred to BNFL.

11. Plutonium was not produced continually for the weapons programme from these reactors. During periods when they were not required for defence purposes their operation was optimised for electricity generation by UKAEA/BNFL. They were maintained as defence stand-by facilities and, since international safeguards requirements applied, have been fuelled from safeguards excluded stocks of uranium. On 18 April 1995 the Foreign Secretary announced that the UK has ceased the production of fissile material for explosive purposes. Arrangements were subsequently made to bring the Calder Hall reactors under Euratom safeguards and make liable to inspection under the terms of the safeguards agreement between the UK, Euratom and the IAEA. The Chapelcross reactors are still used for producing tritium for nuclear weapons and are not subject to international safeguards inspection. However, the SDR announced that all reprocessing of spent fuel from defence reactors at Chapelcross will in future be conducted under Euratom safeguards and made liable to inspection by IAEA. This is now the case, irradiated fuel from the Chapelcross reactors is brought into safeguards on arrival at Sellafield.

12. The first Civil Magnox stations came on line in 1961 and were operated by the Central Electricity Generating Board (CEGB). The fuel from all the civil stations was sent to the same reprocessing facility at

Sellafield as used for spent fuel from Calder Hall and Chapelcross. The reprocessing plant was initially operated on a campaign basis to segregate weapons grade material, to maintain the isotopic purity of the plutonium. MoD has always relied on BNFL, even in recent years, for UK production of nuclear materials.

13. Some plutonium for civil programmes, in addition to plutonium for the defence programme, was also shipped to Aldermaston (when part of UKAEA) for subsequent transfer to other sites or for use in fuel development work. For example Aldermaston;

- developed non-metallic fuel (consisting of mixed plutonium and uranium oxide or carbide) for the fast reactor development programme at Dounreay;
- received material for fuel development for Harwell and Winfrith. Considerable development work was carried out for the ZEBRA (Zero Energy Breeder Reactor Assembly) reactor at Winfrith;
- sent analytical samples and other material for research programmes from both the civil and military stockpiles to Harwell.

This work diminished as a result of transferring Aldermaston to the MOD and the increasing focus of that establishment on the defence mission. There was also increasing segregation of the civil and military programmes as a result of the implementation of safeguards within the civil nuclear industry.

Plutonium

14. Plutonium is a radioactive element that exists in many isotopic forms (different forms of the same element only varying by the number of neutrons in the nucleus of the atom). Plutonium-239 is produced when uranium-238 in reactor fuel absorbs a neutron and then decays to plutonium. This plutonium isotope is preferred for making nuclear weapons. As fuel in a reactor becomes exposed to neutron irradiation, higher isotopes of plutonium build up as additional neutrons are absorbed, creating plutonium-240, plutonium-241and plutonium-242. To produce relatively pure plutonium-239 for weapon purposes the fuel rods are removed from the reactor and reprocessed after a relatively short irradiation. For power production the fuel is left in the reactor much longer to increase efficiency, resulting in a much greater concentration of the higher isotopes of plutonium. Any plutonium with more than 8 percent plutonium-240 is known in the UK as reactor grade (alternatively referred to as "O" Grade). Plutonium containing 8 percent or less plutonium-240 is known as weapons grade (alternatively referred to as "A" Grade in the UK).

International Safeguards

15. The Non-Proliferation Treaty (NPT) has placed obligations on the five Nuclear Weapon States (NWS) of the United Kingdom, United States, France, Russia and China. The NPT also obliges NNWS party to the Treaty not to manufacture or otherwise acquire nuclear weapons. NNWS are obliged to conclude a comprehensive safeguards agreement with the International Atomic Energy Agency (IAEA). Such agreements provide for measures to deter and detect the diversion of nuclear material from peaceful uses to nuclear weapons or other nuclear explosive devices. A comprehensive safeguards agreement is not required of the NWS parties although each has agreed a Voluntary Offer Safeguards Agreement with the IAEA.

16. The UK has also been subject to the 1957 Euratom Treaty since joining the European Community in 1973. All nuclear material in the UK not intended for defence purposes is therefore subject to reporting to, and inspection by, the Euratom safeguards inspectorate.

17. Plutonium that is held outside safeguards for defence purposes is subject to a stringent regime of controls and audits. Site operators are responsible for; the physical security of the material, instituting controls for accurate accountancy of the quantity of plutonium held and its location, raising detailed accounts and having robust internal audit arrangements. The MoD conducts an independent assessment of the site systems, audits the accounts and conducts physical inventory checks.

SECTION 3: RECORD REVIEW

Details of the Review

18. This study is similar in scope, from the UK perspective, to the major United States Department of Energy (USDOE) programme of work to account for defence stocks of nuclear materials. The conclusions

of the US material accounting review for defence stocks of plutonium were published in February 1996 in the report; "Plutonium: The First 50 years".

19. The most important factor in being able to derive a detailed account of the defence stocks of plutonium is access to complete and accurate records. Records were raised when material was transferred between sites (and within sites for local accounting procedures). This review has been conducted primarily from an audit of annual accounts and delivery records from Sellafield supported by receipt records at Aldermaston where these are available. The quality and completeness of records held by Sellafield is, overall, very good. However, for earlier years, the accountancy detail recorded, though fully acceptable at the time, is to a different standard to that required today. The early Sellafield transfer source documents have been destroyed but details of transfers off-site are contained in the annual accounts. As early documentation for moves from other sites is not available or incomplete, evidence has been sought from all available secondary sources. There is therefore a risk that the information available is not complete. In addition to the Sellafield accounts, Aldermaston movement orders and other documentation were used to produce derived accounts for Aldermaston for the period where original accounts are not available. Records at the UKAEA sites were also examined, where available.

20. Confidence is high for the completeness and accuracy of the information obtained for the 1980s and 1990s as the primary transfer records are still available. Prior to this period confidence falls with elapsed time, particularly that before the mid-1960s. The exception to this is the confidence obtained from the good quality Sellafield records for plutonium movements for all periods, which accounts for the great bulk of the material transferred.

21. In general, weapons grade plutonium would have been separated from spent fuel at Sellafield and delivered to Aldermaston for manufacture of weapon components. However, there were other more minor routes by which plutonium was transferred to and from Aldermaston as outlined in Paragraph 13, where material was supplied to support civil development work at Aldermaston, which have been examined to give a full picture of material movements. The situation was also complicated up to 1985 by the return of plutonium process residues from Aldermaston to Sellafield for recovery and then subsequent return to Aldermaston for re-use. Care has been taken in examining the accounts not to double count any of these acquisitions/removals.

SECTION 4: RESULTS OF THE REVIEW

Plutonium Material Balance for Transfers To/From Aldermaston

22. An overall summary account of acquisitions and removals of plutonium for Aldermaston has been drawn up (Table 1) based on receipts from Sellafield and other sources and issues from Aldermaston. The cumulative inventory difference for the period from 1952 is 0.29 tonnes. An annual breakdown of transfers of plutonium between Aldermaston and other UK sites is given in the attached Tables 2-5, compiled from available documentation. Acquisitions were predominantly from Sellafield. Removals were from Aldermaston to Harwell, Dounreay, Winfrith, USDOE, and plutonium was used in weapons tests and assigned to waste.

23. A more detailed discussion of the acquisitions data in Table 1 is given below:

- *From Establishments in Tables 2-5*: The 15.99 tonnes of plutonium received by Aldermaston is for material for the weapons programme, for Barter movements to the US (see section 5) and for work in support of civil programmes commenced by Aldermaston when they were part of UKAEA.
- *From US (0.47t):* Plutonium transferred from the US. These transfers remain classified and are therefore not broken down further.
- *From Unidentified Sites (0.37t):* A few records from the early years do not identify the source of the transfer.
- *Inventory Difference (0.29t):* this balances the acquisition and removals calculation (Paragraph 26 below describes how this was calculated)

24. A more detailed discussion of the removals data in Table 1 is given below:
To Establishments in Tables 2-5 (7.50 t):

- *The removals to Sellafield (Table 2) (3.93 t) constitute the return of residues to*

the recovery plant. Not all this material would be for Defence purposes as the civil work at Aldermaston also generated residues that were returned to Sellafield for treatment.

- *In the early years while Aldermaston was under UKAEA management, there were several cooperative programmes of work with other UKAEA sites. In the period 1958-1977 Aldermaston sent 0.22t of plutonium to Dounreay (Table 3), in association with uranium as oxide or carbide, in support of development of fuel for the fast reactor development work at Dounreay. Aldermaston also undertook fuel development work in support of the ZEBRA reactor at Winfrith. In the period 1961-1984 fuel containing a total of 2.82t of plutonium (Table 4) was sent to Winfrith for use in the civil programme. Both these activities were in support of civil objectives. This material transferred to Aldermaston in support of civil applications was not subject to Euratom safeguards after 1973 because of the need to protect national security information and facilities on the site. Once Aldermaston was incorporated into MoD in 1973 there was a steady closing down of civil development work.*

- *Some transfers were made to Harwell (Table 5) in support of both military and civil programmes. These transfers were mainly contained in samples for chemical analysis, for small-scale research studies or for waste disposal. The records for the early years do not allow an easy distinction between the civil and military programmes. However, a clear 12kg of the 0.53t transferred to Harwell was designated as stock belonging to the civil programme.*

To US (0.47t): Plutonium transferred to the US. These transfers remain classified and are therefore not broken down further.

- *Expended in Tests (0.20t):* This constitutes the transfer of material for weapon tests in Australia, Christmas Island and in the US. A further breakdown of this quantity is not given as this could reveal classified information. This information is published for the first time.

- *Barter Material Issued to US (5.37t):* The material sent via Aldermaston to the US for the various Barter transactions constitutes another route where plutonium left the site. A total of 5.37t were sent to the US in return for 6.7kg of tritium and 7.5t of high enriched uranium over the period 1960-1979.

- *Discards/Sea Dump/Transfers to Waste (0.07t)* includes:

  - discarded waste as either liquid effluent or in solid waste sent to the low level waste disposal site at Drigg

  - the quantity of material that was disposed of to sea, before sea dumping was discontinued in 1983

  - waste currently stored on the Aldermaston site awaiting final disposal, but written off of the stockpile accounts.

25. *Stockpile (3.51t):* The weapon cycle stock figure, comprising the total plutonium held at AWE sites and that which is in service, was published in the SDR and is known accurately using modern material accounting practices. It stands at 3.51t at the baseline date for this study of 31 March 1999. This includes the 0.3t of weapons grade plutonium declared as excess to military requirements in the SDR, some of which has since been moved from Aldermaston to Sellafield and placed under international safeguards.

26. The cumulative inventory difference is the difference between the amount of material accounted for in this exercise as being delivered to Aldermaston and the quantity measured by physical inventories. This is calculated;

INVENTORY DIFFERENCE = PHYSICAL INVENTORY - BOOK INVENTORY
Where: Physical Inventory = Weapon Cycle Stock
Book Inventory = Acquisitions - Removals

Applying the equation above gives a positive cumulative inventory difference indicating that the stockpile contains more material, by 0.29t, than can be confirmed by examination of the available documents. The explanation for this discrepancy is due to the poorer quality and completeness of some of the older records. It can never be certain that all transfer records have been preserved. The records are of variable quality in the period of the 1950s and early 1960s. Other factors such as the technology available, measurement uncertainties and inaccuracies and sampling problems also contribute to this figure. However, the overall level of the Inventory Difference is low in comparison to the amount of material delivered to Aldermaston, at some 1.7% of plutonium delivered.

27. A readily identifiable net transfer of 2386kg (3053kg issued – 667kg received from Dounreay, Winfrith and Harwell) of plutonium was recorded from Aldermaston to other UKAEA sites in support of civil development work. The net removal of plutonium for civil programmes indicates that there was no diversion to the nuclear weapons programme, as far as the scope of this study could determine.

28. Calder and Chapelcross reactors also produced substantial quantities of reactor grade plutonium. This resulted from the periods when the reactors were solely used for generating electricity or also for tritium production in the case of Chapelcross. Some of this material was used in the Barter programme with the US. The plutonium stored at Sellafield has now been placed under safeguards as stated in the SDR. Ownership of this plutonium is split between MOD and BNFL depending on which organisation owned the fuel and received the benefits of reactor operation. It is in a similar oxide form to all the other plutonium from Magnox reprocessing stored at Sellafield and was only kept segregated because it was unsafeguarded. Ownership was assessed by past usage of the reactors.

29. MOD has never had a requirement for the reactor grade plutonium stored at Sellafield in the weapons programme and it has been regarded more as a by-product of material production. It was retained outside of safeguards inspection to protect against calculation of the quantity of weapons grade plutonium produced. Knowledge of the capabilities of the Calder Hall and Chapelcross Magnox reactors and the amount of reactor grade produced would have given some credence to informed estimates of weapons grade production.

SECTION 5: BARTER ARRANGEMENTS

30. Between 1960 and 1979 the UK supplied the US with approximately 5.4 tonnes of plutonium under the 1958 UK/US Mutual Defence Agreement (MDA) which enables transfers between the UK and US of special nuclear materials. The material was supplied in three tranches; known respectively as Barters A, B and C. Barters A and C came from the military production reactors at Calder Hall and Chapelcross, whereas civil Magnox reactors also produced some material for Barter B. In exchange, the UK received from the US 6.7kg of tritium and 7.5 tonnes of high enriched uranium (HEU) for Defence applications.

31. As part of the ongoing USDOE fundamental classification policy review, details of the quantities of material involved in the Barter exchanges were released in December 1997, expanding on the information provided on the total quantities published in February 1996. Both announcements by the USDOE had the support of the UK Government. The quantities of plutonium involved were:

- Barter A (1960-1969) - 0.5 tonne
- Barter B (1964-1969) - 4.1 tonnes
- Barter C (1975-1979) - 0.8 tonne

32. Further background information was also released, including the breakdown of the isotopic composition of the plutonium sent to the US. Prior to 1964, some plutonium received by the US was used for military purposes. Given that this material was derived from UK military stocks and was exchanged under a military agreement, however, it was only to be expected that it would have been used in the US weapons programme. However, although in principle the 1958 US/UK MDA allowed the US to use plutonium produced in civil UK reactors for nuclear weapons, the US undertook in 1964 not to do so. Civilian programmes include californium production and reactor research. Barter C was not subject to the 1964 statement as all of the UK plutonium was obtained from the military reactors. Some of the plutonium received under Barter C was used in US nuclear weapons.

33. The timescale between start-up of the first civil reactors in August 1961 and the time involved for irradiation of fuel, cooling, reprocessing and shipment to the US would have been considerable. In practice, therefore, it is extremely unlikely that any civil plutonium was supplied to the US before the

announcement in 1964 that no civil plutonium was to be used in the US weapons programmes.

34. The arguments presented in Paragraph 2 make it clear that the records do not exist to trace categorically, with the practice of co-processing of fuel from civil and military reactors, the fate of actual atoms of civil fuel. However, the overall accounts are used to ascribe the appropriate customer liability. This is analogous to the practice of financial accounting, individual notes are not physically traced, but each customers account is kept balanced. It is therefore a fruitless task at this distance to pursue any attempt to trace the fate of civil fuel when it has already been acknowledged that UK civil plutonium has been used in Barter B. The US Government has given assurances that it was not used in the US nuclear weapons programme

SECTION 6: CONCLUSIONS

A study has been made of plutonium production for the nuclear weapons programme as outlined in the SDR, in support of the Government's openness initiative. A comprehensive investigation of existing records has revealed a positive 1.7% discrepancy in the through life inventory of plutonium at Aldermaston - ie. the stockpile contains more material than has been confirmed by the accounting exercise. This is regarded as a reasonable outcome given the long period covered and the limited availability of records for the early years.

ANNEX 1

RELEVANT UK NUCLEAR SITES DISCUSSED IN THIS REPORT

Springfields	Uranium Ore Storage, treatment and fuel fabrication	Transferred to BNFL in 1971
Chapelcross	Dual purpose (plutonium, tritium and power production) reactors, Tritium processing	Transferred to BNFL in 1971
Windscale (Sellafield)and Calder Hall	Windscale Piles, dual purpose plutonium production and power reactors, reprocessing plant	Transferred to BNFL in 1971. UKAEA leases part of site and retain responsibility for the Piles
Aldermaston	Nuclear weapons R&D	MOD owned from 1973
Burghfield	Warhead Assembly	Transferred to AWE from ROF in 1987
Other Facilities:		
Foulness	Weapon trials (non nuclear)	MOD owned from 1973
Cardiff	Depleted uranium fabrication	MOD owned from 1973
Dounreay	Fast reactor R&D	UKAEA site
Harwell	Research	UKAEA site
Winfrith	Reactor R&D	

TABLE 1

CONSOLIDATED SUMMARY ACCOUNT FOR ALDERMASTON PLUTONIUM TRANSFERS UP TO 31 MARCH 1999

ACQUISITIONS	
From Sources in Tables 2-5	15.99
From US	0.47
From Unidentified Sites	0.37
Inventory Difference	0.29
TOTAL ACQUISITIONS	**17.12**

REMOVALS	
To Establishments in Tables 2-5	7.50
To US	0.47
Expended in Tests	0.20
Barter Material Issued to US	5.37
Discards/Sea Dump/Transfers to Waste	0.07
Stockpile	3.51
TOTAL REMOVALS	**17.12**

TABLE 2

TRANSFERS BETWEEN ALDERMASTON AND SELLAFIELD

YEAR	Pu DELIVERED (kg)		YEAR	Pu DELIVERED (kg)	
	From Sellafield	To Sellafield		From Sellafield	To Sellafield
1952/53	20.3		1975/76	184.1	130.4
1953/54	89.9	6.7	1976/77	183.7	83.0
1954/55	72.9	4.6	1977/78	257.2	146.7
1955/56	75.0	8.8	1978/79	410.1	37.7
1956/57	90.6	11.2	1979/80	186.8	24.7
1957/58	115.2	20.0	1980/81	*	10.7
1958/59	155.2	19.7	1981/82	*	109.2
1959/60	150.3	17.6	1982/83	169.3	72.5
1960/61	271.5	17.2	1983/84	95.7	203.2
1961/62	436.2	39.5	1984/85	155.4	107.4
1962/63	486.1	236.7	1985/86	124.8	
1963/64	289.4	186.1	1986/87	*	
1964/65	437.4	108.8	1987/88	*	
1965/66	776.4	161.3	1988/89	*	
1966/67	920.1	223.6	1989/90	180.9	
1967/68	1527.2	251.2	1990/91	270.7	
1968/69	1963.4	416.7	1991/92	178.7	
1969/70	1314.6	174.2	1992/93	268.1	
1970/71	713.3	211.2	1993/94	180.9	
1971/72	799.8	241.9	1994/95	171.2	*
1972/73	420.4	291.0	1995/96	21.3	
1973/74	217.6	237.8	1996/97	*	
1974/75	293.9	120.4	1997/98	*	
			1998/99	*	
			TOTAL	**14675.6**	**3931.7**

* indicates transfer of less than 0.1kg

TABLE 3

TRANSFERS BETWEEN ALDERMASTON AND DOUNREAY

YEAR	Pu DELIVERED (kg)		YEAR	Pu DELIVERED (kg)	
	From Dounreay	To Dounreay		From Dounreay	To Dounreay
1952/53			1975/76		4.5
1953/54			1976/77	*	100.6
1954/55			1977/78		

1955/56			1978/79		
1956/57			1979/80		
1957/58			1980/81		
1958/59		0.1	1981/82		
1959/60		6.9	1982/83		
1960/61	3.1	3.0	1983/84		
1961/62	0.2	3.4	1984/85		
1962/63	127.6	5.5	1985/86		
1963/64	0.3	3.6	1986/87		
1964/65	0.9	4.9	1987/88		
1965/66	0.5	7.9	1988/89		
1966/67		10.6	1989/90		
1967/68	0.1	4.6	1990/91		
1968/69		2.2	1991/92		
1969/70	2.7	3.2	1992/93		
1970/71	2.8	1.4	1993/94		
1971/72	5.5	1.7	1994/95		
1972/73		4.2	1995/96		
1973/74		33.2	1996/97		
1974/75		20.0	1997/98		
			1998/99		
			TOTAL	**143.7**	**221.5**

* indicates transfer of less than 0.1kg

- plutonium in spent fuel transferred to Dounreay from Aldermaston research reactors is not included in this Table – this report only deals with separated plutonium

TABLE 4

TRANSFERS BETWEEN ALDERMASTON AND WINFRITH

YEAR	Pu DELIVERED (kg)		YEAR	Pu DELIVERED (kg)	
	From Winfrith	To Winfrith		From Winfrith	To Winfrith
1952/53			1975/76	110.7	43.4
1953/54			1976/77		
1954/55			1977/78		
1955/56			1978/79		
1956/57			1979/80	0.1	
1957/58			1980/81		
1958/59			1981/82		
1959/60			1982/83		25.1
1960/61			1983/84		8.2
1961/62		15.3	1984/85		
1962/63		0.1	1985/86		
1963/64	2.0	104.0	1986/87		
1964/65	24.9	122.9	1987/88		
1965/66	144.6	248.4	1988/89		

1966/67	1.2	16.6	1989/90		
1967/68	0.1	0.1	1990/91		
1968/69	0.6	*	1991/92		
1969/70	89.8	0.6	1992/93		
1970/71	118.3	561.9	1993/94		
1971/72	0.2	1163.8	1994/95		
1972/73	4.0	255.8	1995/96		
1973/74	70.0	256.4	1996/97		
1974/75	82.1		1997/98		
			1998/99		
			TOTAL	**648.6**	**2822.6**

* indicates transfer of less than 0.1kg

TABLE 5

TRANSFERS BETWEEN ALDERMASTON AND HARWELL

YEAR	Pu DELIVERED (kg)		YEAR	Pu DELIVERED (kg)	
	From Harwell	To Harwell		From Harwell	To Harwell
1952/53			1975/76	0.1	1.0
1953/54			1976/77	0.4	*
1954/55			1977/78	4.4	0.5
1955/56			1978/79		*
1956/57			1979/80	*	1.3
1957/58	10.9	9.8	1980/81	*	5.0
1958/59	19.2		1981/82	0.9	15.7
1959/60			1982/83	97.4	147.4
1960/61	*	6.0	1983/84	265.6	239.6
1961/62		6.4	1984/85	4.4	3.6
1962/63		4.8	1985/86	5.8	4.9
1963/64	3.8	8.9	1986/87	10.4	5.5
1964/65	3.4	9.3	1987/88	2.5	13.3
1965/66	0.5	0.4	1988/89	18.1	3.6
1966/67	0.2	0.2	1989/90	5.5	11.9
1967/68	0.4	2.3	1990/91	8.9	12.4
1968/69		0.8	1991/92	9.9	5.9
1969/70	*	2.2	1992/93	38.2	5.3
1970/71	0.1	0.1	1993/94	1.2	1.2
1971/72	*	*	1994/95	0.6	0.4
1972/73	0.4	0.1	1995/96	0.3	0.2
1973/74	1.8	0.1	1996/97	0.2	0.1
1974/75	5.4	3.8	1997/98	0.2	0.3
			1998/99	0.2	
			TOTAL	**521.3**	**534.3**

* indicates transfer of less than 0.1kg