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**AUSTRALIAN NUCLEAR SCIENCE  
AND TECHNOLOGY ORGANISATION**

**LUCAS HEIGHTS RESEARCH LABORATORIES**

**NUCLEAR MATERIALS MANAGEMENT PROCEDURES**

by

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ABSTRACT

This manual describes the procedures for the management of nuclear materials and associated materials at the Lucas Heights Research Laboratories. The procedures are designed to comply with Australia's nuclear non-proliferation obligations to the International Atomic Energy Agency (IAEA), bilateral agreements with other countries and ANSTO's responsibilities under the Nuclear Non-Proliferation (Safeguards) Act, 1987. The manual replaces those issued by the Australian Atomic Energy Commission in 1959, 1960 and 1969.

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## 1. INTRODUCTION

The Australian Nuclear Science and Technology Organisation (ANSTO) maintains a system of procedures for the accountancy and physical control of nuclear materials and associated materials at the Lucas Heights Research Laboratories (LHRL). The procedures are designed to meet four requirements:

- (i) The physical control and material accounting responsibilities of ANSTO.
- (ii) The responsibilities of ANSTO to the Australian Safeguards Office (ASO) in accordance with the Nuclear Non-Proliferation (Safeguards) Act, 1987 (the Safeguards Act).
- (iii) The obligations of Australia under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). These obligations are set out in the Safeguards Agreement between Australia and the International Atomic Energy Agency (the Safeguards Agreement). The Safeguards Agreement is recorded in the IAEA publication INFCIRC/217.
- (iv) The obligations of Australia under its bilateral agreements with other countries.

In accordance with the Safeguards Act, ANSTO is required to account for and control nuclear material and associated material. In accordance with the Safeguards Agreement, Australia is required to establish a State System of Accounting for and Control of Nuclear Material (SSAC). The Australian SSAC is administered by the ASO.

## 2. DEFINITION OF NUCLEAR MATERIAL AND ASSOCIATED MATERIAL

The term "nuclear material" used in this manual includes associated material. In accordance with the Safeguards Agreement and the Safeguards Act, nuclear material is defined as follows:

- (i) The term "special fissionable material" means plutonium-239; uranium-233; uranium enriched in the isotopes 235 or 233; any material containing one or more of the foregoing; and such other fissionable material as the Board of Governors (of the IAEA) shall from time to time determine; but the term "special fissionable material" does not include source material.
- (ii) The term "uranium enriched in the isotopes 235 or 233" means uranium containing the isotopes 235 or 233 or both in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is greater than the ratio of the isotope 235 to the isotope 238 occurring in nature.
- (iii) The term "source material" means uranium containing the mixture of isotopes occurring in nature; uranium depleted in the isotope 235; thorium; any of the foregoing in the form of metal, alloy, chemical compound, or concentrate; any other material containing one or more of the foregoing in such concentration as the Board of Governors shall from time to time determine; and such other material as the Board of Governors shall from time to time determine.
- (iv) Associated material is nuclear grade graphite and heavy water (D<sub>2</sub>O).

## 3. SCOPE OF THIS MANUAL

The materials falling within the scope of the procedures set out in this manual are listed below.

### 3.1 Safeguards Agreement

Nuclear Materials : Uranium, thorium, plutonium and their oxides  
and uranium hexafluoride

Associated Materials : None

Batch Number Prefix : "N"

Reports : Monthly

### 3.2 Safeguards Act

Nuclear Materials : Uranium, thorium, plutonium and their oxides  
and uranium hexafluoride  
Compounds, concentrates, ores and  
minerals containing uranium and thorium

Associated Materials : Nuclear grade graphite  
and heavy water

Batch Number Prefix : "F"

Reports : Six-monthly

All special fissionable materials as defined in section 2.1(i) above are subject to safeguards under both the Safeguards Agreement and the Safeguards Act.

Source materials for non-nuclear use as defined in section 2.1(iii) may be exempted from safeguards under the Safeguards Agreement by arrangement with the IAEA. Such exempted materials are still subject to safeguards under the Safeguards Act unless also exempted under the Safeguards Act.

### 4. UNITS

Special fissionable materials are accounted for in grams, and individual transactions are recorded to the nearest 0.01 g. Source materials are accounted for in kilograms, and individual transactions are recorded to the nearest 0.01 kg.

The associated material heavy water is accounted for in kilograms and nuclear grade graphite is accounted for in tonnes.

### 5. MANAGEMENT PROCEDURES

#### 5.1 General Outline

These procedures provide for the supply and control of nuclear materials to the various ANSTO and CSIRO Divisions at LHRL and also to external organisations on request. Materials are issued to Divisions at LHRL through the Nuclear Safeguards Officer (NSO) to Authorised Officers (AO). The AOs assume responsibility for the material and report on the status of the material, as required, to the NSO.

#### 5.2 Material Balance Areas

For the purposes of accounting for and control of nuclear materials under the Safeguards Agreement, LHRL is divided into four Material Balance Areas (MBAs).

The MBAs are

- (i) MBA AS-A (HIFAR reactor, ANSTO), see figure 1,
- (ii) MBA AS-B (Moata reactor, ANSTO), see figure 2,
- (iii) MBA AS-C (Lucas Heights Research Laboratories), see figure 3, and
- (iv) MBA AS-D (Critical Facility, ANSTO).

In addition to the above MBAs, an MBA designated AS-E exists for locations in Australia other than LHRL. The procedures for issue and receipt of nuclear material for this MBA is consistent with the procedures for the MBAs at LHRL.

#### 5.3 Nuclear Safeguards Officer

The NSO is appointed by the Executive Director and is responsible to the Head, Technical Services Section (or other nominee of the Executive Director) for the overall control of nuclear materials at LHRL. These responsibilities include the following:

- Provisioning/Purchasing (liaison with Manager, Contracts and Supply).
- Transport.
- Safeguards Inspections (liaison with IAEA and ASO).
- Receipts/Issues.
- Security and Storage (in consultation with the Director, ANSTO Security).
- Sale/Hire.
- Disposal.
- Reports to ASO.
- Reports to the ANSTO Management.
- Maintaining an Accountancy System.

### **5.3.1 Provisioning/purchasing of material**

The provisioning and purchase of nuclear materials is arranged in accordance with the requirements of the ANSTO accounting and supply procedures. The NSO is responsible for consolidating the requirements of all Divisions with those necessary to supplement the NSO's stocks and for the introduction into the supply system of the necessary documents, fully supported by a justification for the requirements to ensure that the ANSTO financial targets for the particular year are met.

A detailed estimate and any revision of that estimate covering the total year's requirements is submitted by the NSO to the Controller, Finance and Supply, by the dates stipulated by the Controller.

### **5.3.2 Transport of material**

#### **(i) Transport within LHRL**

The AOs are responsible for the transport of nuclear materials under their control. However the NSO must be informed before any movement takes place and be satisfied that the relevant safety approvals have been obtained.

In the case of movement of HIFAR fuel elements from within the reactor sealed building to Building 23, the AO need not inform the NSO each time there is such a movement, but will ensure that relevant criticality and safety approvals are current.

At the end of each HIFAR operating program, the NSO must be informed of the location of each fuel element, together with the accountancy data for the burnup and nuclear production.

#### **(ii) Transport outside LHRL**

Transport outside the LHRL includes transport interstate, intrastate or overseas by land, sea or air. The NSO coordinates the preparation and submission of proposals for

- (a) specification and/or approval of container or package design, lifting and carriage;
- (b) transport arrangements, including necessary action in the event of an emergency;
- (c) ensuring that all state and international transport requirements are met, including intermediate ports of call; and
- (d) liaison with Government authorities having related responsibilities (e.g. ASO, Department of Trade, NSW Health Department.)

The NSO will advise the Head, Contracts and Supply Section, on transport arrangements of shipments to or from Australia, and if necessary obtain advice from specialist sections at the LHRL.

The Head, Contracts and Supply Section in consultation with the NSO, will ensure that the relevant administrative approvals, such as export/import licences, customs clearances, shipping documents, etc. have been obtained prior to the transport of the nuclear material.

The NSO and the Head, Contracts and Supply Section will liaise on all movements of nuclear materials outside the Lucas Heights Research Laboratories.

All transport of nuclear materials at the LHRL will be carried out under the conditions set out in the AAEC Safety Directive SD1/86 (an ANSTO Safety Directive is to be issued).

### 5.3.3 Receipt of Material

All nuclear material is allocated a batch number on receipt and retains this number until either its physical and/or chemical form is changed or it is moved from one location to another. Any change in batch number will be made by the NSO. An "F" or "N" prefix is given to the batch in accordance with details in section 3 of this manual.

### 5.3.4 Inspection of material

Following receipt of nuclear materials, including fuel elements from overseas suppliers, the NSO must ensure that they are inspected promptly so that any advice of rejection may be forwarded to the supplier within the required time. (Appendix A, Inspection report for HIFAR fuel element).

The receipt inspection of reactor fuel elements will be made by the NSO and a representative of the Division which operates the reactor concerned. Division Chiefs may arrange similar representation at inspections of materials purchased for their projects. Details of these inspections are recorded in inspection reports and, in the case of HIFAR fuel, on fuel element history sheets (Appendix B, ROS Form 510).

If materials or fuel elements are rejected, a technical report stating the reasons for the rejection will be prepared by the NSO and forwarded to the Head, Contracts and Supply Section, for action in accordance with ANSTO's accounting and supply procedures.

### 5.3.5 Issue of material

The NSO will issue nuclear materials only to AOs and only for use in areas approved by the Chief, Health and Safety Division and/or the Criticality Officer for the amount of materials involved.

Requests for the issue of material must be made to the NSO. The AOs will contact the NSO for advice on available material, quantity and form.

If the specified form of nuclear material requires preparation (for example, fabrication or chemical processing), the NSO may advise where these services can be obtained at the LHRL, but all subsequent negotiations are between the persons requesting and those supplying the services.

### 5.3.6 Limits on quantity of material

The AOs may request the following amounts against a project:

- (i) Special fissionable material - up to 50 g of plutonium,  $^{235}\text{U}$  or  $^{233}\text{U}$ . (This refers to the contained isotope(s), NOT the element weight.)
- (ii) Depleted uranium - up to 500 kg.
- (iii) Natural uranium or thorium - up to 100 kg.

For amounts in excess of the above, a Division Chief's approval is necessary.

The NSO together with the AO must check that the amount of special fissionable material held in the laboratory does not exceed the amount allowed by the Criticality Officer (AAEC Safety Directive SD1/86).

### 5.3.7 Security and storage of material

The Director, Security is responsible for all policy matters concerning physical security of nuclear materials. Minimum security standards must meet the requirements of INFCIRC 225 (Rev. 1), 'The Physical Protection of Nuclear Materials.' In addition to separate records being kept for "N" and "F" materials, it is important that the two types of material are stored separately. Article 39 of the Safeguards Agreement forbids 'exempted' material being stored with safeguarded material.

Information on stocks of nuclear materials may be given to persons only on a 'need-to-know' basis.

### 5.3.8 Sale or hire of nuclear material

All requests for the sale or hire of nuclear materials from ANSTO are directed in the first instance to the NSO who provides a statement showing the feasibility of supplying the material from the LHRL and the probable cost.

The NSO will

- (i) advise the Head, Commercial Services Section, of the proposed transaction and request any special instructions that must be observed;
- (ii) withhold any further action on the sale or hire until the advice of the Head, Commercial Services Section has been received;
- (iii) arrange for execution of the purchase or hire agreement on the approved form in accordance with the ANSTO accounting procedures; and
- (iv) on completion of the agreement as in (iii) above the NSO will arrange dispatch of the material.

The calculation of costs and invoicing procedures will be in accordance with normal ANSTO commercial practices.

#### **5.3.9 Disposal of material**

Nuclear material must not knowingly be disposed of via laboratory or process wastes (for example, waste bins or effluent drains). When unwanted products containing nuclear materials are generated in operations, they must be segregated, to allow the quantity of nuclear materials to be measured or estimated, and then transferred to the NSO.

It is emphasised that the quantity of unwanted nuclear material must either be measured or estimated on the basis of measurement. The quantity must not be assumed to be the difference between the measurement before the experiment or process and the measurement after the experiment or process. Details of measurements should be made available to the NSO.

The NSO recommends whether the unwanted products should be treated to recover the nuclear materials, stored for possible recovery at a later date, or sent for disposal. In making the recommendation, for approval by the Division Chief, Technical and Commercial Services Division the NSO will consider the probable cost of recovery compared with the value of the contained material.

If the material is to be recovered, the NSO will negotiate with the section which can supply the necessary services.

If material is approved for disposal as waste, the NSO will transfer the material to the Leader, Waste Management Section, who will arrange for disposal or storage.

The responsibility for accounting for material sent for disposal or storage remains with the NSO. The Leader, Waste Management Section, as an AO, signs the movement voucher only to certify that the material described and identified by others has been received. The disposal or storage reference number must be shown on the movement voucher, so that subsequent reference can be made to the disposal or storage records.

#### **5.4 Authorised Officers**

Authorised Officers are nominated by Division Chiefs and approved by the Executive Director. The AOs are responsible for the transport, storage, control and accounting of nuclear materials issued to them. The AO's records of receipt, location, usage, transfer, loss, disposal and return of materials are maintained in a form approved by the NSO.

The Division Chief ensures that, as far as is practicable, the officer(s) nominated for this duty have a close and direct interest in the use of the nuclear materials for which they accept responsibility.

A list of AOs is maintained by the NSO and a report on the efficiency of AOs is prepared by the NSO, if required.

##### **5.4.1 Records to be maintained by Authorised Officers**

The records kept by the AOs should contain, where applicable, the following information:

- (i) reference to the movement voucher (Appendix C);
- (ii) ANSTO nuclear material batch number;



- (iii) chemical and physical form;
- (iv) weights: gross, net, contained element(s), contained isotope(s);
- (v) number(s) of project(s) in which materials are used;
- (vi) location of material and details of security;
- (vii) details of all disposals or losses, including dates and document reference;
- (viii) weight in hot storage, reactor(s) and cold storage; and
- (ix) irradiation data.

NOTE: The term 'hot storage' is used for irradiated fuel elements and 'cold storage' is used for fresh or unirradiated fuel elements.

Nuclear materials or their containers must be clearly labelled with the batch number(s) and the weight(s) of the current content of accountable nuclear materials. Where the amount of special fissionable material being processed exceeds 1 kg per month, the NSO may require the AO to report on the state of material at frequent intervals.

## 6. NUCLEAR MATERIALS COMPUTERISED CONTROL AND ACCOUNTANCY SYSTEM

A computerised nuclear materials control and accounting system was established in 1984 to replace the earlier manual ledger system. All previous manual records are included in the data base.

### 6.1 Functions of the System

The system is centrally operated by the NSO. The data files contain all the information necessary for the following purposes:

- (i) Inventory change reports (ICR) - **Appendix D**.
- (ii) Database inventory listings (DBIL) for each MBA - **Appendix E**.
- (iii) Material balance reports (MBR) - **Appendix F**.
- (iv) AOs' holdings of nuclear materials.
- (v) List of AOs.
- (vi) Location of nuclear materials.
- (vii) Listing of nuclear materials by category and enrichment.
- (viii) Listing of batches.
- (ix) Control report for auditing purposes.
- (x) Listing of nuclear materials by the inventory change classification given in **Appendix G**.
- (xi) Bilateral agreement reports. (Australia/USA; Australia/UK; Australia/Canada).
- (xii) Costing reports.

Full details of the system are given in NFC 45 (an AAEC internal report), and are available on a 'need to know' basis.

### 6.2 Accounting procedure

If nuclear material is subject to any of the following changes, there must be an accounting action:

- (a) Any of the changes appearing in **Appendix G**.
- (b) Change of location within the same MBA.
- (c) Transfer from one AO to another within the same MBA.
- (d) Change of chemical and/or physical form.

The accounting procedure is carried out at two levels:

- (i) The AO advises the NSO of the changes and records them. These records may be kept manually or on computer.
- (ii) The NMO enters all the details of the change into the appropriate data file, and then produces a movement voucher. This voucher is sent to the appropriate AO for a signature. The AO retain a copy of the voucher.

The NSO will from time to time and at least once a year, check the holdings shown by the AO's account against the computer listing.

## **7. NUCLEAR MATERIAL INVENTORY**

### **7.1 Inventory Taking**

To check that the physical quantity of nuclear material present agrees with the quantity in the accounts, it is necessary to carry out a physical check from time to time. This check is referred to as Physical Inventory Taking (PIT). For the purposes of inventory taking the MBAs are sub-divided into Key Measurement Points (KMPs) designated with an alphabetical nomenclature. A KMP is defined in the Safeguards Agreement as the location where nuclear material appears in such a form that it may be measured to determine material flow or inventory. (A numerical designation applies to material flow KMPs). Thus, KMPs include, but are not limited to, the inputs and outputs (including measured discards) and storages in the MBAs.

Each KMP is under the control of one or more AOs, hence the inventory listing of the AOs will give the inventory listing in that KMP. All inventory items appearing on the listing may be physically checked, weighed, sampled and tested by non-destructive analysis where appropriate. If all items are not checked, then a sample check based on a random sample plan may be taken.

A physical inventory is carried out in all MBAs at least once a year. In practice, inventory taking for the "N" file (NPT listing) is usually done when the IAEA inspectors are carrying out physical inventory verification.

### **7.2 Material Unaccounted For**

The inventory listing for a batch in the accounts is compared with the physical inventory amount and the difference is defined as the Material Unaccounted For (MUF) in that batch.

In the Safeguards Agreement, a batch is defined as an amount of nuclear material handled as an accounting unit at a KMP and for which the composition and quantity are defined by a single set of specifications and measurements. The material may be in bulk form or as a number of discrete items.

### **7.3 Mixing of Batches**

It is essential that the mixing of nuclear materials from different batches be controlled and that all proposals to mix materials be referred to the NSO. The NSO will consider the proposal and recommend an alternative if materials cannot be mixed. Mixing and blending of batches is restricted by conditions described in both the Safeguards Agreement and bilateral agreements.

### **7.4 Loss of Nuclear Material**

Losses of nuclear material may arise in any of the following ways:

- (a) Accidental loss of a known quantity of nuclear material as a result of an operational accident.
- (b) Operational loss of a measured and/or estimated (on the basis of measurement) quantity of nuclear material from processing, which has been disposed of in such a way that it is not suitable for further nuclear use.
- (c) An unaccountable loss of material discovered when a physical inventory is being taken. This loss is known as MUF (see **section 6.2** above).
- (d) An unaccountable loss of material discovered at a time other than when a physical inventory is being taken

Should there be a loss of nuclear material, safety action must be taken immediately to ensure that there is no consequent hazard.

Should there be a loss of one or more grams of plutonium,  $^{235}\text{U}$  and/or  $^{233}\text{U}$  or more than one kilogram of source material, the NSO must be advised immediately after the loss is detected. The NSO will immediately notify the following:

- (i) The Criticality Officer and the Chief, Health and Safety Division so that they may take action according to AAEC Safety Directive SD1/86.
- (ii) The Director, ANSTO Security if the circumstances indicate that it is a security matter.
- (iii) The Executive Director or the delegated officer.
- (iv) The Australian Safeguards Office (ASO).

The following officers may authorise the NMO to adjust the data files to take account of the above losses:

- (a) Division Chief  
Not more than 100 g (total) of plutonium,  $^{235}\text{U}$ ,  $^{233}\text{U}$  or 100 kg of source material in a six-month period.
- (b) Deputy Director  
More than 100 g of plutonium,  $^{235}\text{U}$  and/or  $^{233}\text{U}$  or more than 100 kg of source material in a six-month period.

NOTE: The above refers only to the adjustment of data files. Authority to write off must be in accordance with the ANSTO financial account and supply procedures.

### 7.5 Nuclear Production/Loss

The production of fissionable material such as plutonium or  $^{233}\text{U}$  in a reactor, or the loss of nuclear material due to its transformation into other elements or isotopes as a result of nuclear reaction is calculated.

A computer program HIFUEL is run by the Reactor Operations Section and provides full details on the production of plutonium, burnup of  $^{235}\text{U}$  and formation of  $^{236}\text{U}$ . The computer program is run every four weeks. A copy of the printout is sent to the NSO. Full details of nuclear production and nuclear loss for any individual element or group of elements are available from the Reactor Operations Section.

It should be noted that under the Safeguards Agreement all HIFAR and Moata fuel is accounted for as fresh fuel. This is specified in the Facility Attachments to the Safeguards Agreement. Only on shipment of irradiated fuel is the burnup taken into account, and the nuclear loss is reported. No plutonium production is reported for either reactor.

## 8. ACKNOWLEDGEMENTS

The authors acknowledge the contributions made by the authors of the earlier editions and are grateful to all those who proffered advice and made comments on the draft.

## 9. ABBREVIATIONS

These abbreviations are used in this report and the accompanying illustrations. Abbreviations identifying the type of inventory change are listed in **Appendix G**.

AAEC	Australian Atomic Energy Commission
ADU	Ammonium Diuranate
ANSTO	Australian Nuclear Science and Technology
AO	Authorised Officer
ASO	Australian Safeguards Office
CSIRO	Commonwealth Scientific and Industrial Research Organisation
D	Depleted (uranium)
DBIL	Data Base Inventory Listing
E	Enriched (uranium)
HAHC	High Activity Handling Cell
IAEA	International Atomic Energy Agency
ICR	Inventory Change Report
INFCE	International Nuclear Fuel Cycle Evaluation
INFCIRC	<i>Information Circular of the IAEA</i>
KMP	Key Measurement Point
LHRL	Lucas Heights Research Laboratories
MBA	Material Balance Area
MBR	Material Balance Report
MUF	Material Unaccounted For
N	Natural (uranium)
NFC	Nuclear Fuel Cycle
NSO	Nuclear Safeguards Officer
NPT	Treaty on Non-Proliferation of Nuclear Weapons
PIL	Physical Inventory Listing
Pu/Be	Plutonium/Beryllium
U/Al	Uranium/Aluminium.

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NOTES

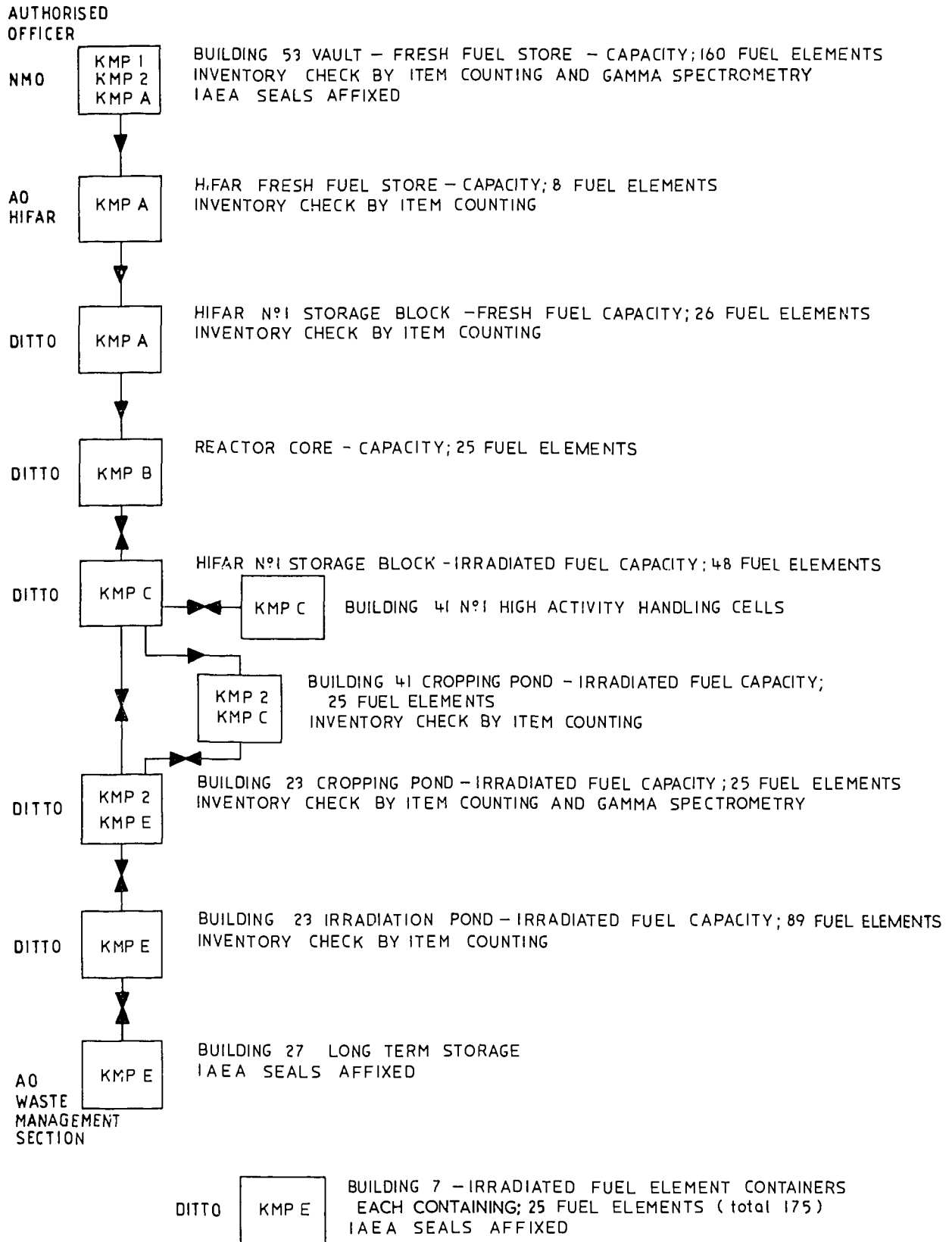


Figure 1 FLOW SHEET FOR FUEL ELEMENTS IN HIFAR MBA AS-A  
(see AAEC Drawing No.E100001 for building locations)

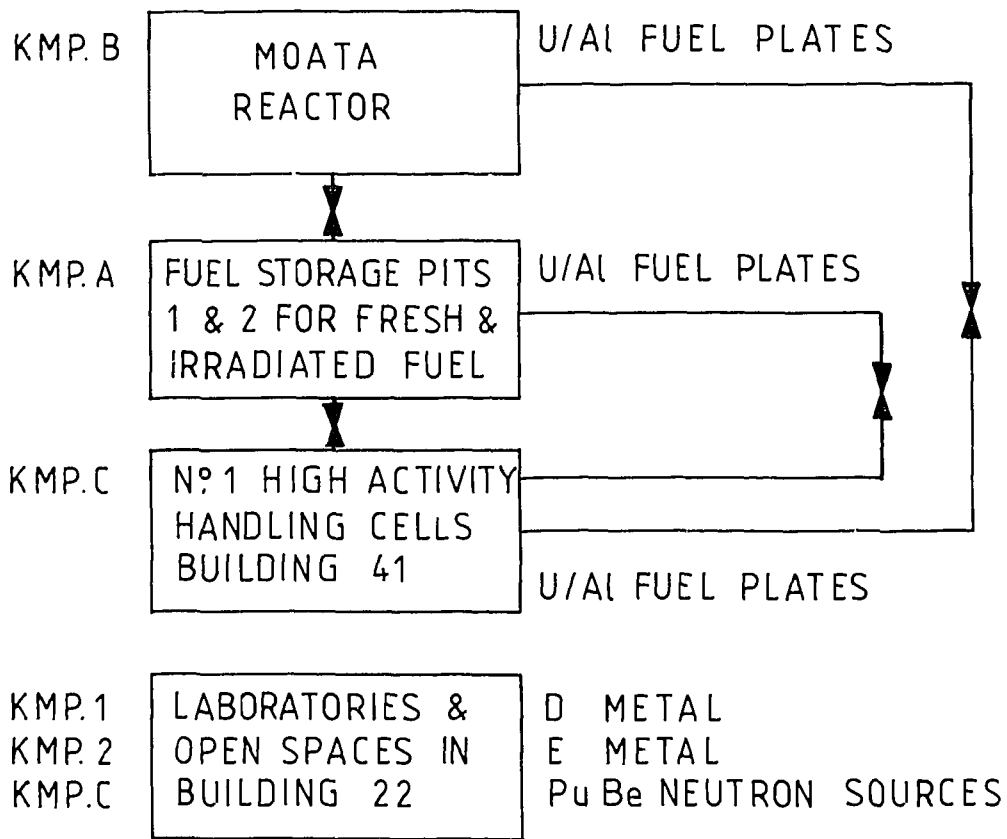


Figure 2 FLOW SHEET FOR NUCLEAR MATERIAL IN MBA AS-B MOATA, BUILDING 22  
(see AAEC drawing No.E100001 for building location)

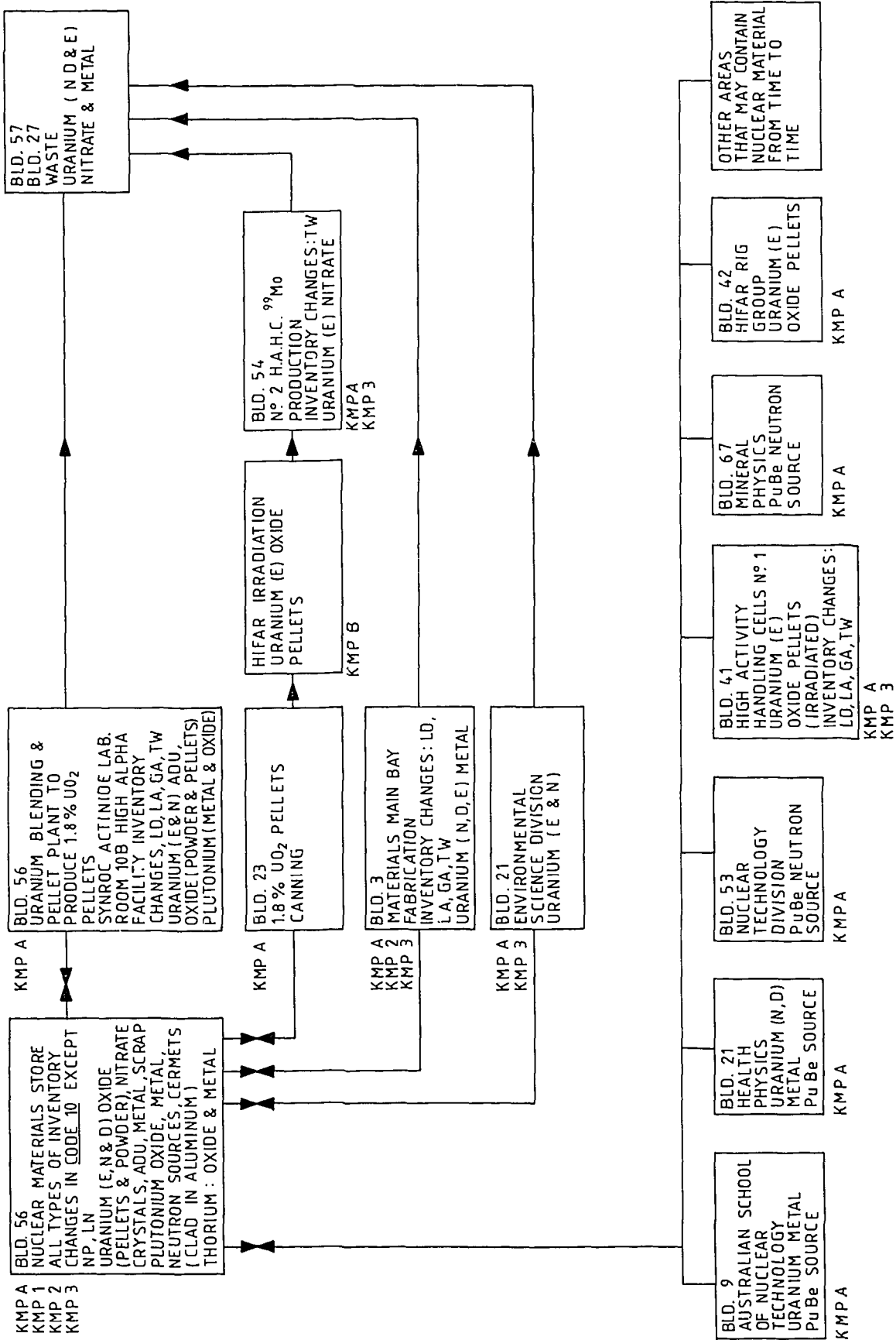


Figure 3 NUCLEAR MATERIAL FLOW CHART - RESEARCH LOCATIONS IHI MBA AS-C



NOTES

**APPENDIX A  
INSPECTION REPORT FOR HIFAR FUEL ELEMENT, SERIAL NO. 4/20 099**

DATE RECEIVED in store .....

DATE inspected 24 3 : 83 .....

- NB. 1) The FE components check is to be in accordance with the current FE. drawing approved by H.O.S.
- 2) Give details of any observed irregularity and or item(s) found unacceptable in the Remarks' Section below.
- 3) For non applicable items write N/A

<u>CHECK LIST</u>	<u>ACCEPTABLE</u>	<u>UNACCEPTABLE</u>
	(tick off as required)	
1. SERIAL NO. CLARITY	/	
2. OVERALL CLEANLINESS	/	
3. COOLING OUTLET PORTS	/	
4. SPRAY COOLING ASSY.	/	
5. T/C TUBE ASSY.	/	
6. OVERALL LENGTH OF F.E.	/	
7. O - DIA. RING GAUGE	/	
8. I - DIA. NOSE CONE GAUGE	/	
9. FUEL TUBES AND COMBS ASSEMBLY	/	
10. T/C COMB DRAIN HOLE	/	
11. APPEARANCE OF ALL WELDS	/	
12. INTERNAL TEST MANDREL	/	
13. SALVAGE FLANGE	/	
14. WEIGHT OF F.E. = <u>.59.67</u> grams		

REMARKS:

APPENDIX B  
HIFAR FUEL ELEMENT HISTORY SHEET

Element No. 420 099

ROS-FORM 510 (a)

1. <u>PRE-ASSEMBLY - R.S.G.</u>							SIGNATURE		DATE	
U.K. Inspection Certificate No. <u>C09470</u> dated <u>13.10.82</u>							<u>MS IER</u>			
Initial U <sup>5</sup> : <u>119.43 g</u> Initial total U : <u>199.24 g</u>							<u>M.T.R</u>			
Receipt Inspection : <u>Not/Acceptable for HIFAR</u> .....							<u>R. E. McC</u>		<u>24.3.83</u>	
2. <u>ASSEMBLY - R.S.G.</u>										
Drawn from vault on <u>28/8/85</u> , R.I.V. No. <u>M863</u>							<u>R. E. McC</u>		<u>28/8/85</u>	
Assembled to Plug No. <u>AREC 17</u> , (new clamps fitted/not fitted)							<u>R. E. McC</u>		<u>2-9-85</u>	
T/C checked, <u>OK</u> .										
Inspection report										
3. <u>OPERATION - R.A.G.</u>										
O.P. No.	Load Date	Lattice Pos'n	Insert	Depth Gauge	Unload Date	Energy MWD	U <sup>5</sup> g	U <sup>tot</sup> g		
333	19-9-85	D2	F.S.A.1.			12.078	134.34	186.34	<u>G. L. G. G. G.</u> 22-10-85	
334		"	"			11.001	120.63	174.59	<u>G. L. G. G. G.</u> 18-11-85	
335		"	"			10.204	107.95	163.70	<u>G. L. G. G. G.</u> 19-12-85	
336		"	"		10-1-86	10.029	95.53	152.99	<u>G. L. G. G. G.</u> 13-1-86	
339	6-3-86	A4	FSA 12			7.25	86.6	145.34	<u>J. J. J.</u> 4-4-86	
340		"	"			12.000	78.73	138.45	<u>J. J. J.</u> 7-5-86	
Residence Time : <u>6</u>						TOTALS :	<u>56.959</u>	<u>78.73</u>	<u>138.45</u>	<u>G. L. G. G. G.</u> 7-5-86
U <sup>5</sup> B/U : <u>70.7 g</u> Total U B/U : <u>60.76 g</u>										
Element no longer required for HIFAR .....								<u>R. E. McC</u> 1/1/86		
4. <u>CROPPING - R.S.G.</u>										
Authorised for cropping .....							<u>R. E. McC</u>		<u>13-5-86</u>	
T/C removed .....							<u>R. E. McC</u>		<u>15-5-86</u>	
Sheared into <u>Position No 4</u> .....										
Cropped in .....										
5. <u>TRANSFER AFTER CROPPING - R.S.G.</u>										
Transferred to .....							Authorized by			
Transferred by .....							<u>R. E. McC</u>		<u>13-6-86</u>	
Received by .....							<u>J. J. J.</u>		<u>13/6/86</u>	
6. <u>DISPOSAL - W.D.G.</u>										
Reference T.V. No. _____ B.27 hole No. _____ Pos'n No. _____										
7. <u>REMARKS</u>										

APPENDIX C  
MOVEMENT VOUCHER

MOVEMENT VOUCHER F206  
\*\*\*\*\*

ANSTO - Nuclear Materials Management - LHRL  
-----

ICR -----

Batch No. N21208

Date: 870512

Previous Batch No. N164  
[where applicable]

ACTION [BS] BATCH CHANGE, SAME MBA, REC & DESP

-----  
[ ]Sale [ ]Loan-Lease [ ]Ship/Rec. Differences [ ]Return to N.M.Control  
=====

From: NUC. MAT. CONTROL C  
Address: BLD 56 ROOM 1  
Area Code: C-A

To: LA RIVIERE, MR. C.  
Address: BLD 23 ROOM 33  
Area Code: C-A

CODE	MATERIAL DESCR.	%	ENR.	GROSS	Weights in G		ISOTOPE
					NET	ELEMENT	
GRGB	UO2 POWDER	7		0.0	0.0	19.18	1.34
						ENRICHED U	235
No. of Items:		1					

Additional Information [References, etc.]

Despatching Authorised  
Officer

Section Head or Division  
Chief endorsement  
[if required]

Receiving Authorised  
Officer

*[Signature]*  
12/5/87

1/1

*[Signature]*  
14/5/87

=====

TRANSPORT: The material is packed in the following manner

The transport arrangements will be

-----  
Nuclear Materials Officer  
=====

Remarks:

Remarks:

-----  
Criticality Officer

-----  
Chief, Health & Safety Division  
=====

APPENDIX D  
INVENTORY CHANGE REPORT [ICR] FORM R.01.1/C

Country: AUSTRALIA  
Facility: RESEARCH LABS.  
Material Balance Area: AS-C  
Period covered by report - From: 841101 to: 841130  
Report Number: ----- Page ----- of ----- Pages

Signature -----

E. N. T. R. Y.	C. O. N. T. R. O. L. N. O.	D. A. T. E.	M. O. D. E. L. / C. O. U. N. T. R. Y.	T. Y. P. E.	K. I. T. S.	I. T. E. M. S.	I. N. M. A. T.	W. A. T. C. H. N. U. M. B. E. R.	W. A. T. C. H. D. E. S. C.	E. L. E. M. E. N. T.	A. C. C. O. U. N. T. A. N. C. Y. D. A. T. A.		C. O. R. R. E. C. T. I. O. N.
											W. E. I. G. H. T. (K. G. / S. T.)	L. O. O. N. J. Y.	
1	841112	AS-E	AS-C	RD	1	1	0010	D		1.96KG	0.0	I	
2	841112	AS-C	AS-C	RM	2	1	0010	D		1.96KG	0.0	I	
3	841112	AS-C	AS-C	RP	1	6	0010	D		1.96KG	0.0	I	
4	841112	AS-C	AS-C	TR	3	1	FK00	E		399.91G	7.20	0	H
5	841113	AS-C	AS-C	TU	2	2	0010	D		52.50KG	0.0	I	
6	841115	AS-C	AS-C	TW	3	1	0331	E		1226.92G	23.08	0	H
7	841122	AS-C	AS-C	RM	2	13	0010	D		183.00KG	0.0	I	
8	841122	AS-C	AS-C	RP	1	13	0010	D		183.00KG	0.0	I	
9	841129	AS-C	AS-E	SD	2	1	0010	D		2.00KG	0.0	H	
10	841130	AS-C	AS-A	SD	2	1	0300	P		10.00G	0.0	I	

M696  
M697  
M698  
M699  
M701  
M703  
M706  
M707  
M708  
M709

APPENDIX E  
DATA BASE INVENTORY LISTING [DBIL]

Country: AUSTRALIA  
Facility: MOATA REACTOR  
Material Balance Area: AS-B

Date: 3 SEP 86  
Report No. ....  
Page No. .... of .... Pages

Signature .....

```

.....
E.           ,         ACCOUNTANCY DATA           , C.
N.C.        ,         -----           , N.
T.O. K.     , ITEMS.   , ELEMENT , FISSION   , O. CORRECTION
R.N. M.     , BATCH, IN , MAT , , WEIGHT , WEIGHTCGJ , T.   TO
Y.T. P.     , No. , BATCH, DESC. E.  , [KKG/GJ] , [U only] , I.M. E. REPORT ENTRY.
.....

```

			ITEMS		ELEMENT	FISSION						
1	B	N019	1	FUOK	E	1.85G		1.72	G	T	---	-----
2	B	N020-1	112	D34G	E	2741.70G		2458.70	G	T	---	-----
3	B	N023-1	29	D34G	E	705.86G		634.20	G	T	---	-----
4	B	N028	1	QSB8	F	15.97G		0.0	T	---	-----	-----
5	C	N017	1	OD1A	E	0.13G		0.12	G	T	---	-----
6	C	N018	1	D32F	E	11.26G		10.10	G	T	---	-----
7	C	N020-2	32	D31G	E	781.42G		700.84	G	T	---	-----
8	C	N021	1	D31G	E	12.18G		10.92	G	T	---	-----
9	C	N022	1	D31G	E	6.18G		5.54	G	T	---	-----
10	C	N023-2	15	D31G	E	365.49G		328.39	G	T	---	-----
11	C	N027	1	QSB8	F	9.99G		0.0	T	---	-----	-----
12	C	N030	1	QSB8	F	1.19G		0.0	T	---	-----	-----
13	C	N116	524	OD1A	D	1282.48KG		0.0	T	---	-----	-----
14	C	N140	11	OD1A	E	1.15G		0.08	G	T	---	-----
15	C	N199-B	1	QGBE	E	4.46G		0.13	G	M	---	-----
16	C	N118	1	OD1A	E	79.10G		73.56	G	L	---	-----
17	C	N057-B	1	OD1A	D	7.50KG		0.0	M	---	-----	-----
18	C	N142	2	FQAA	E	2.78G		2.58	G	L	---	-----
19	C	N045E2	1	FQAB	F	98.88G		0.0	L	---	-----	-----

APPENDIX F  
MATERIAL BALANCE REPORT [MBR]

Country: AUSTRALIA  
Facility: RESEARCH LABS.  
Material Balance Area: AS-C

Period: From 830701 To 840601  
Report No. ....  
Page No. .... of ..... Pages

Signature .....

ACCOUNTANCY DATA									
E N T R Y	C O R R E C T I O N	D E B I T	C R E D I T	E L E M E N T	W E I G H T	U N I T	F I S S I L E	W E I G H T	C O R R E C T I O N
1		FB	D	2572.95	KG		0.0		
2		RD	D	2.47	KG		0.0		
3		RF	D	1020.00	KG		0.0		
4		SD	D	9.97	KG		0.0		
5		TW	D	133.10	KG		0.0		
6		BE	D	3452.35	KG		0.0		
7		PE	D	-----	KG		-----		
8		FB	N	7996.79	KG		0.0		
9		TW	N	2.81	KG		0.0		
10		BE	N	7993.98	KG		0.0		
11		PE	N	-----	KG		-----		
12		FB	E	123018.49	G		4025.88		
13		TW	E	17391.88	G		313.80	G	
14		LD	E	1050.36	G		18.91	G	
15		LA	E	1167.75	G		21.02	G	
16		PE	E	103408.50	G		3672.15		
17		PE	E	-----	G		-----		
18		FB	P	1423.21	G		0.0		
19		SD	P	160.00	G		0.0		
20		BE	P	1263.21	G		0.0		
21		PE	P	-----	G		-----		

**APPENDIX G  
IAEA CODE 10**

'Type of Inventory Change' One of the following keywords or their codes should be used in this column in order to indicate the type of inventory change.

Keyword	Code	Explanation
Receipt foreign	RF	Nuclear material imported into Australia.
Receipt domestic	RD	Domestic receipt of nuclear material from another MBA.
Receipt at starting point	RS	Domestic receipt of nuclear material at starting point of safeguards pursuant to Article 35(c) of the Agreement.
Receipt from non-safeguarded activity	RN	Domestic receipt of nuclear from non-safeguarded (permitted military) activity.
Nuclear production	NP	Production of special fissionable material in a reactor (Pu, <sup>233</sup> U).
De-exemption, use	DU	Reapplication on safeguards on nuclear material previously exempted therefrom pursuant to Article 37 of the Agreement.
De-exemption, quantity	DQ	Reapplication of safeguards on nuclear material previously exempted therefrom pursuant to Article 38 of the Agreement.
Shipment foreign	SF	Nuclear material exported out of Australia.
Shipment domestic	SD	Domestic transfer of nuclear material to another MBA.
Return to pre-safeguarded	SS	Transfer of safeguarded nuclear stage material back to pre-safeguarded stage.
Shipment to non-safeguarded	SN	Domestic transfer of nuclear material to non-safeguarded (permitted military) activity.



**APPENDIX G (Continued)**

Nuclear loss	LN	Consumption of nuclear material due to its transformation into other element(s) or isotope(s) as a result of nuclear reactions.
Measured discard	LD	Operational loss - loss of a measured or estimated (on the basis of measurement) quantity of nuclear material from processing which has been disposed of in such a way that it is not suitable for further nuclear use.
Transfer to retained waste	TW	Transfer to the retained waste category of measured nuclear material which is deemed to be irrecoverable, to be stored at the MBA and to be deleted from the inventory of the MBA.
Retransfer from retained waste	FW	Retransfer of material, which had been stored at the MBA as retained waste, to the nuclear material inventory. This applies whenever material in the retained waste category is removed from storage either for processing at the MBA or for shipment from the MBA.
Exemption, use	EU	Exemption of nuclear material from safeguards pursuant to Article 37 of the Agreement.
Exemption, quantity	EQ	Exemption of nuclear material from safeguards pursuant to Article 38 of the Agreement.
Termination, non-nuclear use	TU	Termination of safeguards on nuclear material pursuant to Articles 13 and 36(b) of the Agreement.
Accidental loss	LA	Irrecoverable and inadvertent loss of a known quantity of nuclear material as a result of an operational accident.
Accidental gain	GA	Nuclear material unexpectedly found to be present in the MBA, except when detected at physical inventory taking.

**APPENDIX G (Continued)**

In addition to the changes described above, the inventory may be adjusted in accordance with the results of measurements performed in the material balance area on nuclear material previously recorded and reported on shipper's data. The keyword and the code are as follows:

Shipper/receiver	DI	The difference between the quantity of nuclear material reported as received (always on shipper's data) and the quantity as measured by the operator of the receiving MBA.
Decrease in batch content	RM	The quantity by which the batch mentioned in the entry is diminished.
Increase in batch content	RP	The quantity of material added to the batch mentioned in the entry from another batch.

Extracted from Code 10 of the Subsidiary Arrangements to IN-CIRC/217.