

Appendix 1

Draft methodology for quantification of construction materials and wastes

As the first stage of this project, there is a clear need to attempt to quantify the likely waste arising from the decommissioning processes.

Step 1 Identify the sites

There has been very considerable activity in the decommissioning process. Some reactors have been fully dismantled, others have been decommissioned and are in long term maintenance and work is current elsewhere. There needs to be clarity as to which sites are to be covered by the study.

For the sake of accountability, there should also be justification of why these sites have been chosen and if any seemingly suitable candidate sites have been omitted, why that is so.

This work will need to be done in close collaboration with UKAEA.

Step 2 Within each site identify the buildings and infrastructure to be included

This is probably best done by exclusion, that is to say buildings, utilities, pipework etc. that will NOT form part of the work should be identified for specific exclusion. The reasons for the exclusions should be given. It is assumed that drawings are readily available unlike most developed sites where this information can be difficult or impractical to recover.

Step 3 Identify/ agree on material types

In a conventional study material types would be selected by composition and grouped where properties are similar e.g.

- Concrete, brick and tile
- Timber (softwood)
- Glass
- Metals, ferrous
- Metals, non ferrous
- Plaster and plaster board
- Architectural components
- Plastics
- Liquid chemicals
- Vegetation
- Soil

In this project there are more variables, particularly in respect of special material types. The level of exposure to radioactivity and the residual (surface) level of radioactive contamination may be known. If so this would be a further category of sorting. It is now assumed however that all the materials included in the study are exempt or free release in levels of activity.

The special materials (such as lead added to concrete, very high strength concrete etc.) need to be identified as sub groups of the main material types so that their recovery route can be differentiated to suit the material properties.

Step 4 Identify treatment options

Despite the fact that all materials will be exempt or free release, there may still be treatments that would increase levels of public confidence in the acceptability of secondary use. The likelihood remains however that materials will largely be destined for reuse on controlled sites.

Step 5 Assess quantities by material type

Having set the categories the material will be quantified:

- a) from assessment of 'typical' buildings using as-built drawings, and liaison with on site staff, assess quantities by material type and by level of radioactivity, to identify materials covered by the study.
- b) from a), make estimates of overall quantities of exempt and free release materials by material type, by site.

A reasonable degree of accuracy will be possible when quantifying the overall volumes/weights of materials. The degree of accuracy will decline as the materials are increasingly subdivided into more specific categories given the level of input available on this study. There needs to be agreement therefore on how far to subdivide materials.

Materials will arise from:

buildings
foundations
pipework, cable ducts
drainage runs
underground storage facilities
roadways and hardstandings
fencing and walling
hard landscaping
vegetation cover

Material types will be for example:

Generic	Specific	Detailed
Concrete	Mass unreinforced Reinforced with steel Reinforced with special steel Including lead aggregate Mortar rendering	Low strength High strength
Brick	Engineering brick Fine brick Facing brick	Glazed
Tile	Clay tile Concrete tile	
Metals	Lead Cladding sheet Structural steel Stainless steel GI fixings Aluminium Alloys Copper piping Cast iron Ductile iron Wiring	By grade By grade By grade By type
Plastics	Coatings Frames, cladding Ceilings Ducting Insulation	By type By type By type By type By type
Plaster	Plaster board Plaster rendering Plaster tiles	
Timber	Studwork etc Window/door frames Special elements	Softwood Soft/hard wood Soft/hard wood
Glass	Glazing Glass fibre Glass 'bricks'	

Bituminous	Asphalt Tar and chippings	
Aggregate	Road base Sub base	
Solid and vegetation		

Issues to be agreed:

Access to records

Access to one site as representative of others

Security issues on information: special measures

Materials types: more detail/ less detail

Peter Guthrie

25 July 2002

Appendix 2

**Programme for Visit to Dounreay
7 – 8 October 2002
Professor P Guthrie
Cambridge University**

Monday 7 October

- 0830 Arrive Dounreay Reception
Opening Meeting with **George Linekar** and **Bob Mathews** (D8538/1)
- 0900 Discussions with **Dave Broughton** - Plans for LLW Disposal
- 1130 **Paul McCelland** and **Mike Brown** – Waste Management of Materials and Waste Assay
- 1230 Buffet lunch in D8538/1
- 1345 Transport to PFR
- 1400 Tour of PFR with **Alan Robertson**
- 1515 Transport from PFR

Tuesday 8 October

- 0830 Arrive Dounreay Reception
- 0845 **Neil Buchan** – ILW and Shaft
- 1100 **Tom Todd** – Design Standards and Material Specifications
- 1230 Buffet lunch in D8538/1
- 1345 Transport to Puma Cell
- 1400 Tour of Puma Cell with **Stuart Brown**
- 1500 Transport from Puma cell
- 1500 **Mark Liddiard** – Environmental Regulations

Appendix 3

The Environment Council stakeholder dialogue methodology

Developing sustainable practices in managing Very Low Level Waste (VLLW) and free-release construction materials in nuclear industry decommissioning - Scoping Phase Stakeholder Dialogue Summary

Background

UKAEA and a number of other liability holders in the nuclear industry have recognised the need to develop guidance with stakeholders to deal sustainably with its historic nuclear liabilities, particularly very low-level waste (VLLW) produced by the industry, much of which comprises of construction materials. The nuclear industry has identified some areas which need addressing including sustainability indicators, quantifying the materials on site and producing a sustainability framework to enable the discharge of liabilities. The overall project will be managed by CIRIA.

The Environment Council has been invited to design and run an initial scoping dialogue to obtain stakeholder input into the way forward for the project. CIRIA and the industry have committed to continuing this project as a stakeholder dialogue after the initial scoping meeting, subject to obtaining funding.

Aims of the Stakeholder Dialogue for the Scoping Study

The stakeholder dialogue for this phase would be an initial scoping meeting. The aims of the meeting would be to:

- inform stakeholders on the current ideas in the industry for the VLLW project
- gather and clarify issues and concerns from stakeholders
- explore with stakeholders the priorities for a dialogue process
- explore and agree a way forward for stakeholder engagement in this project
- ensure the process is open and transparent

The Environment Council & Stakeholder Dialogue

The Environment Council is a UK-based independent charity which aims to benefit people and the environment through:

- promoting agreed solutions to environment and sustainability issues; and
- enabling parties to work together to resolve environmental challenges.

The Environment Council were pivotal in bringing the concept of *Stakeholder Dialogue* to the UK 12 years ago. Our intention was to move discussions about environmental choices away from sterile positions and argument, towards agreement and practical action. Besides its professionalism, the Council's success is founded on impartiality. We will only intervene in a situation when asked to do so and will not

take sides in the event of disagreement. Our purpose is to promote mutual trust and a shared commitment to achieving practical, creative solutions that will benefit the public and the environment.

The Environment Council's Way of Working

In discussions around complex issues, the meetings must be carefully managed to ensure that a balance is struck between different stakeholders' needs and expectations. The Environment Council achieves this by using a facilitator, whose active management of the meeting is vital to gain an effective outcome. He or she would keep the discussion focused by:

- recording key points on flipcharts
- making sure the discussions are kept within agreed ground rules and the parameters of the discussion
- avoiding misunderstandings by asking parties for clarification
- separating difficult items into manageable portions - or scheduling them for later
- helping the parties define barriers and incentives to progress
- helping participants acknowledge common ground and build progress around it

The Environment Council works on behalf of all stakeholders and this way of working allows all stakeholders at the meetings to have a full input into the process.

Process Methodology

Every dialogue process run by The Environment Council is custom-designed to meet the needs of the funder and the participants.

This phase of the dialogue involves planning, organising logistics and facilitation of a one-day scoping meeting bringing together 40 participants to discuss the aims outlined above. The output of this meeting will inform the way forward for the project.

We recognise that in order to progress with the project, after the scoping phase, priorities need to be identified and funding sought, however a possible way forward would be to establish one or more working groups. These are smaller cross-sectoral groups, mandated by the main group, which would carry out the substantive work or oversee work carried out on behalf of the dialogue e.g. producing guidance, identifying criteria or engaging research. Working in smaller working groups is much more productive than trying to cover all content issues in a large main group, however the mechanism of feedback and wider main group input is vital. As well as maintaining feedback from the main group during the working group phase it is important to have actual main group meetings as this allows the working group to present their work and answer queries that people may have and discuss any issues they require wider input on.

A steering group or small core group may also be required. The function of this group is purely to consider the process, it does not discuss content issues. If more than one working group is set up, the steering group will ensure that they are

progressing and do not have any repetition in their tasks; it will also ensure that relevant information is passed between groups when appropriate and inform the planning of the workshops.

The Relationship between Stakeholder Dialogue and Business as Usual

In general, participants in stakeholder dialogue agree groundrules by which they will work before each meeting. One of those groundrules is 'business as usual outside the workshops'. We find that this allows the participants to attend workshops without compromising their day-to-day activities.

The Environment Council must make a judgement on the commitment of any funder at the beginning and throughout the stakeholder dialogue process.

Lucy Parnall (including Carl Reynolds modification)
The Environment Council
27 July 02

Appendix 4

The Environment Council's 'Photo report' plus transcription of the stakeholder workshop held at the University of Salford 16 October 2002

(This is only available in hard copy and was sent to all stakeholder delegates and PSG members)

Appendix 5

Peter Guthrie's presentation at the stakeholder workshop 16 Oct 02

Sustainable Practices

Quantification of Wastes

Sustainable Development Context

- "...development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs"

Brundtland 1987



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Sustainable Practices

Quantification of Wastes

Sustainable Development Context

- Actions now must provide protection for the present community,
- taking due account of the risks, and
- build in protection for future generations.
- Actions must be proportional to risk now and in future;
- Disproportionate response as an expedient is non sustainable, diverting resources for unreasonable levels of protection

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Sustainable Practices

Quantification of Wastes

Sustainable Development Context

- Scale of VLLW, Exempt and Free Release materials means that decisions have significant consequences in terms of cost
- Strategies have to be scientifically robust
- Strategies have to be consistent with policy

Sustainable Practices

Quantification of Wastes

Sustainable Development Context

- Process should begin with clarity as to quantities...

Sustainable Practices

How Much ? Dounreay Estimates

Low Level Waste (LLW)

- from the DSRP :-
83,000 m³ LLW

of which

33,000 m³ in Existing Authorised Disposal Facility at Dounreay



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Sustainable Practices

How Much ? Dounreay Estimates

Very Low Level Waste (VLLW)

33,000 m³

Clean/Exempt Waste

120,000 m³



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Sustainable Practices

Dounreay - Relative Decommissioning Waste Volumes (Raw Volumes)

Clean/Exempt	120,000m ³	882	
VLLW	33,000m ³	242	
LLW (includes VLRM)	50,000m ³	367	



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Sustainable Practices

Dounreay- Relative Disposal Costs/Volumes

Waste Material	Cost/Unit Volume	Decommissioning Volumes
Clean/Exempt	£40-60/m ³	120,000m ³
VLLW	£40-60/m ³ *	33,000m ³
LLW (If VLRM included)	£3,000-5,000/m ³	~50,000m ³

* Depends on management option available



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Sustainable Practices



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Sustainable Practices

Material Types

Preliminary Estimate


- Concrete, brick & tile ~75%
- Plaster & Plasterboard ~10%
- Ferrous metals ~10%
- Timber ~1-5%
- Non Ferrous metals <5%
- Soil <2%
- Glass <1%

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Appendix 6


Jeff Kersey's presentation at the stakeholder workshop 16 Oct 02



CIRIA
Pioneers Club

**Sustainable Construction:
implementation of
targets & indicators**

**Sustainable practices ...
16 October 02
Jeff Kersey**



Environment Group

- **Effective protection of the environment**
- **Prudent use of natural resources**
- **Social progress which recognises the needs of everyone**
- **Stable economic growth and employment**



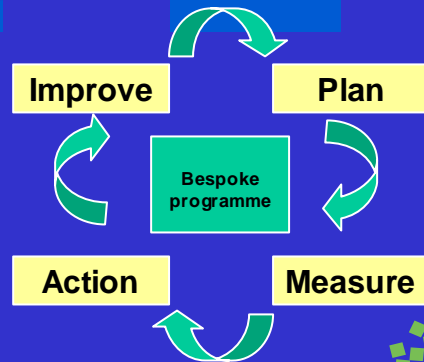
Pioneers Club – flagship project

- 10 construction companies
- Trialling sustainable construction indicators from CIRIA's RP609 report
- Practice not theory



What is the Pioneers Club?

- 2 year programme of *implementation*
- Leading contracting & design companies
- Varied experience of indicators
- Club approach
- Bespoke programmes of implementation
- Build on existing management systems where appropriate



Participants

Companies

Contracting

Balfour Beatty
Carillion
Laing
Taywood
Skanska

Design

Arup
Buro Happold
WS Atkins
Montgomery
Watson Harza
Skanska
WSP

Other orgs

DTI
Royal Bank of Scotland
Forum for the Future



Aims for the participating companies (1)

- Understand role of SCIs in improving performance in relation to key sustainability issues for their business
- Consider internal people issues and the processes for building support for sustainability
- Identify the most appropriate CIRIA indicators – usually about 25 each



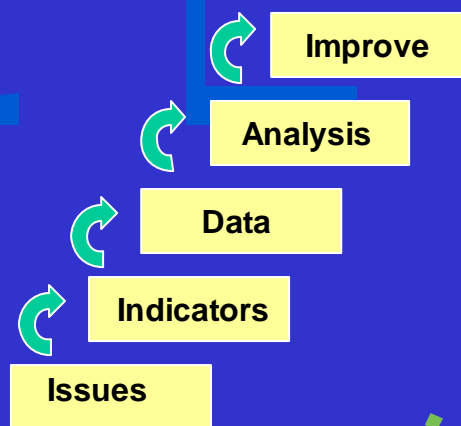
Aims for the participating companies (2)

- Establish effective data collection processes
- Develop a programme to support the implementation process, involving the sharing of experience amongst club members
- Measure company performance and consider future improvements - then report



Process

- Identify key issues for the business
- Choose indicators for these issues
- Establish data compilation procedures
- Collect and analyse data
- Identify necessary improvements



Benefits of performance measurement

- Increase awareness of sustainability issues
- Improve management of information
- Identify priority improvements
- Enable benchmarking
- Assist reporting



The club approach

- Exchange of ideas amongst club members
- Support from CIRIA
- Input from specialist advisers and workshops
- Participation in the Project Steering Group
- Collective marketing strategy



Workshops

- Data collection
- Sustainability training
- Resources
- Formal benchmarking



CIRIA Pioneers Club

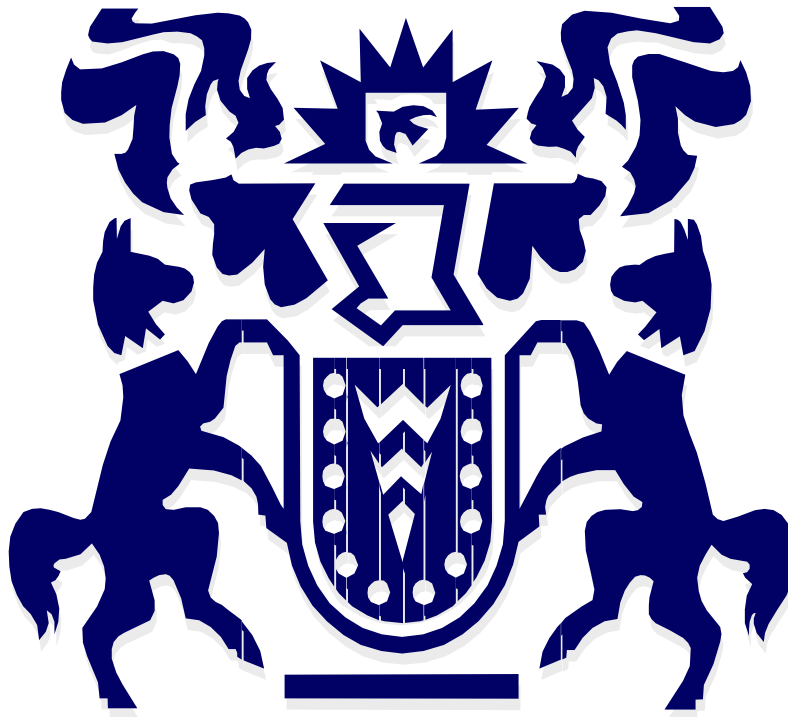
**Sustainable Construction:
implementation of
targets & indicators**

**Sustainable practices ...
16 October 02
Jeff Kersey**



Appendix 7

George Linekar's presentation at the stakeholder workshop 16 Oct 02



**Establishing Dialogue and Sustainable
Practices in meeting Historic Nuclear
Liabilities**

George Linekar
UKAEA

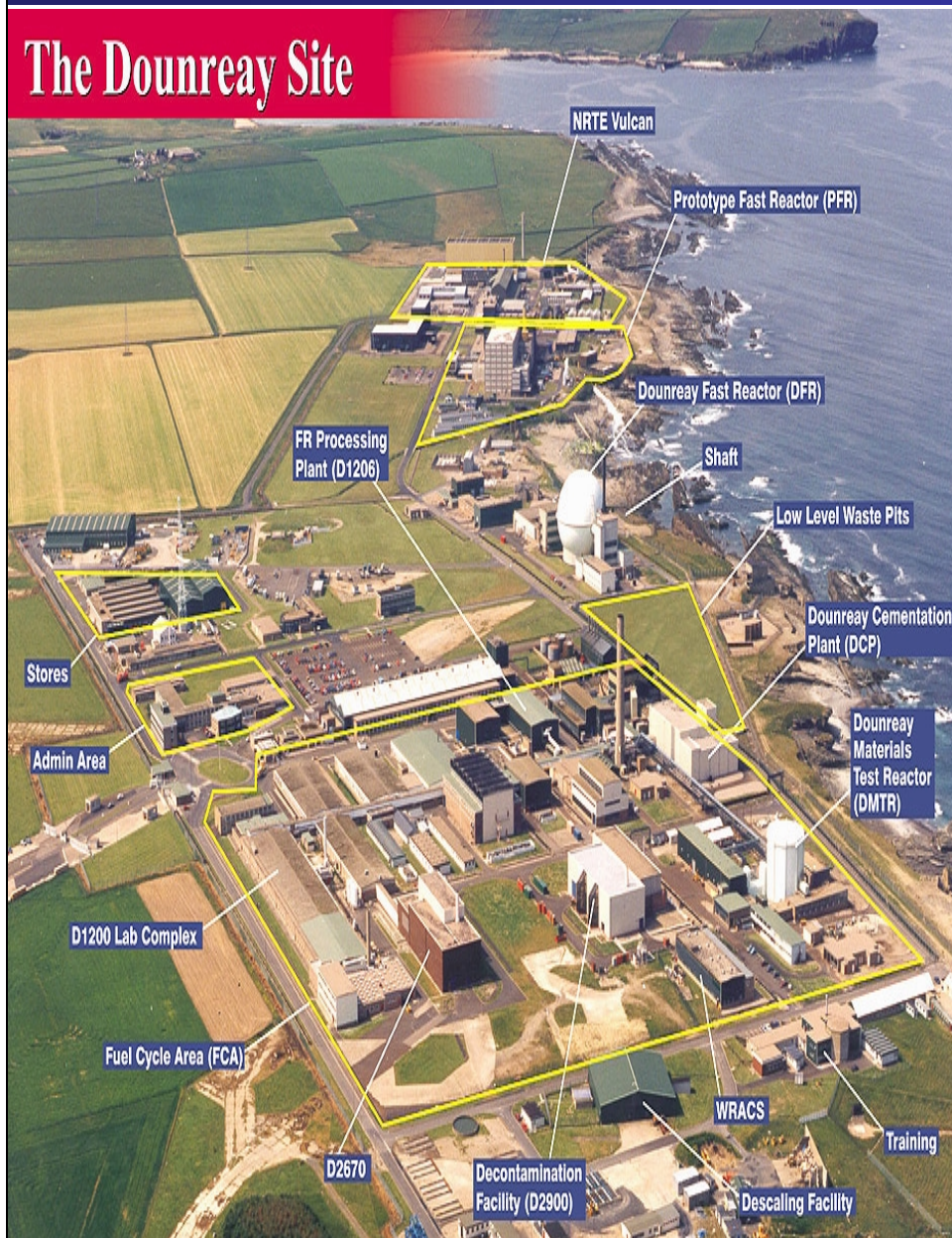
Sustainable Practices

UKAEA Business

- Since 1994 UKAEA established a reputation as a pioneer in the emerging business of nuclear decommissioning
- At our former atomic research and development sites across the UK, providing solutions to the challenges of decommissioning some of Britains oldest and most complex civil nuclear facilities and restoring the land for future use
- Doing this in a way which is
 - Cost effective and safe
 - Ensuring maximum value for money for the taxpayer
 - without compromising the well being of our staff, surrounding communities or the environment
- UKAEA has the principles, systems, tools and whole-life plans in place for the restoration of its sites

Sustainable Practices

The Dounreay Site



Sustainable Practices

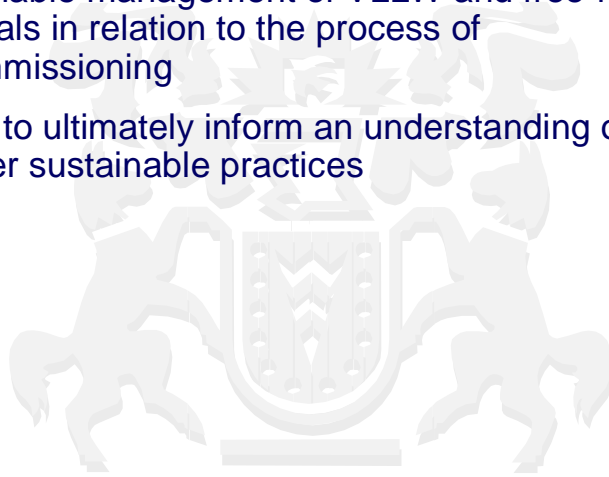
Establishing dialogue and sustainable practices in meeting historic nuclear liabilities

- Liability holders in the UK Nuclear Industry have recognised the need to develop guidance with stakeholders to deal sustainably with their historic nuclear liabilities
- Particularly very low-level waste (VLLW) and free - release materials produced by the industry
- Much of this waste comprises ex-construction materials



Sustainable Practices

- CIRIA has a contract with UKAEA to produce a scoping study “Establishing dialogue and sustainable practices in meeting historic nuclear liabilities”
- Scoping study will focus on issues connected with sustainable management of VLLW and free-release materials in relation to the process of decommissioning
- Aim is to ultimately inform an understanding of broader sustainable practices



Sustainable Practices

Process

- Similar methods to those adopted for the SAFEGROUNDS project
 - Engage stakeholders concerned about the related issues
 - Ensure the projects' processes are open and transparent
 - Project should be 'auditable' by its stakeholders
 - Aim is to build relationships between stakeholders and the nuclear industry
 - Aim to create good relationships for the future by improving communication and mutual understanding

Project Team

UKAEA	George Linekar
The Environment Council	Lucy Parnall
Independent Facilitator	Carl Reynolds
Technical Expert	Prof. Peter Guthrie
CIRIA	Jeff Kersey

Sustainable Practices

Output of Scoping Study

■ Main Output:-

CIRIA will produce, via SITF, publicly available scoping study report which will include:-

– Preliminary Quantification

Providing preliminary inventory of materials on one representative UKAEA site (focus on VLLW and free-release materials)

– Establishing Sustainable Construction Indicators

Presentation on CIRIA's experience developing and implementing sustainable construction indicators

– Preliminary Stakeholder Dialogue

Report on a preliminary stakeholder dialogue process aimed at identifying sustainable practices and producing a 'route map' for how detailed practical industry guidance will be further developed through the process of stakeholder dialogue

Sustainable Practices

Categories of Nuclear Waste

Very Low Level Waste (VLLW) Covers wastes with very low concentrations of radioactivity. It arises from a variety of sources, including hospitals and industry in general. Because VLLW contains little total radioactivity, it can be disposed of safely with domestic refuse either directly at landfill sites or indirectly after incineration.

Low Level Waste (LLW) Includes metals, soil, building rubble and organic materials which arise principally as lightly contaminated miscellaneous scrap. Metals are mostly in the form of redundant equipment. Organic materials are mainly in the form of paper towels, clothing and laboratory equipment that have been used in areas where radioactive materials are used - such as hospitals, research establishments and industry.

Intermediate Level Waste (ILW) This is waste with radioactivity levels exceeding the upper boundaries for LLW but which does not need heating to be taken into account in the design of storage or disposal facilities. ILW arises mainly from the reprocessing of spent fuel, and from the general operation and maintenance of radioactive plant. The major components of ILW are metals and organic materials, with smaller quantities of cement, graphite, glass and ceramics.

High Level Waste (HLW) High Level Waste (HLW) is heat-generating waste that has accumulated since the early 1950s at Sellafield and Dounreay, primarily from the reprocessing of spent nuclear fuel. The temperature in HLW may rise significantly, so this factor has to be taken into account in designing storage or disposal facilities. As with ILW, there is currently no final management strategy for HLW.

Sustainable Practices

A. Radioactive Wastes

Legal definitions of radioactive material and radioactive waste are contained in Section 1 and 2 of the Radioactive Substances Act (RSA '93); the effect of the definitions is that radioactive waste generally includes;

- i) scrap, surplus or spoilt radioactive material, and
- ii) any other waste substance or article which has become radioactive or has acquired an increased concentration of activity

(Guidance on Requirements for Authorisation)

Sustainable Practices

B. Some Waste Definitions

LLW

<4000 Bq/g α
<12000 Bq/g β/γ

Wastes containing radioactive materials other than those acceptable for disposal with ordinary refuse, but not exceeding 4GBq/te α or 12GBq/te β/γ activity (i.e. wastes which, under existing authorisations, can be accepted by BNFL at Drigg, or previously by UKAEA at Dounreay).

VLLW

Zero α
<4 Bq/g β/γ

Wastes which can be safely disposed of with ordinary refuse (dustbin disposal), each 0.1m³ of material containing less than 400kBq β/γ activity or single items containing less than 40kBq β/γ activity. (Note no α allowance)

Exempt

Zero α
<0.4 Bq/g β/γ

Materials which are exempt from regulation through SoLA or Schedule 1 exemption criteria.

Clean Materials

Clean materials are neither contaminated with radioactivity nor activated above background levels.

Sustainable Practices

C. Controlled Burial (P49, Glossary, Cm 2919)

Authorisations are issued for the burial of some LLW at suitable landfill sites which have good containment characteristics. For example, if they have several metres of clay lining.

This controlled burial requires Authorisations under RSA93 and is intended for use by non-nuclear industries which process raw materials containing natural radioactivity, and by major hospitals and universities for their relatively more active waste streams, as well as by BNFL for waste from its uranium enrichment and fuel fabrication plants and for lightly contaminated excavation spoil at its Sellafield site. Usually a site receives waste for controlled burial from no more than one or two sources (p32, CI 114, Cm2919).

Sustainable Practices

D. Exemption Levels

- Under the Substances of Low Activity (SoLA) Exemption Order 1986, solid materials containing man-made radionuclides are exempt from control if the activity is less than $0.4\text{Bq/g}_{\beta/\gamma}$
- Naturally occurring radioactive materials (NORM) are exempt if the radionuclide activities are less than those stated in the Radioactive Substances Act (RSA) Schedule 1 or one of the conditional exemption orders, such as the phosphatic substances, rare earths, etc exemption order
- Organic liquids containing up to 4 Bq/ml of carbon-14 and tritium are exempt. All other liquids containing man-made radionuclides are categorised as low level waste
- Gases containing radionuclides and daughters with half-lives less than 100 seconds are exempt

Sustainable Practices

E. Clean Materials

Clean materials are neither contaminated with radioactivity nor activated above background levels.



Sustainable Practices

Cm 2919

- Acknowledges the need to relieve needless pressure on the disposal capacity of Drigg by making greater use of controlled burial:
- Recognised the sound economic and radiological grounds for encouraging greater use of controlled burial: but
- Recognised the public concern over this issue and concluded that apart from “small users” (which includes Nycomed/Amersham) greater use of controlled burial by the nuclear industry should not be encouraged

Appendix 8

List of present or future issues to be considered during the project

Issues indicated by UKAEA

- The re-use and / or disposal of very low level radioactive waste
- The re-use / disposal of ZnBr
- The treatment of other common materials e.g. lead, graphite, mercury, solvents etc.
- The retention of decommissioning expertise / knowledge within the industry
- The development of common approaches to the justification of BPEO / BPM (e.g. Reference flora / fauna - see Pentreath in JRP, March 2002)
- The development of inter-industry technology registers
- Provision of advice / support to the non-nuclear industry e.g. hospitals / universities
- Collation of relevant information on current UK practice together with that in Europe and the USA, together with any information on developing innovative solutions
- Identification of any lessons that may be learnt from other non-nuclear industries
- Recommendations of where members of SITF could invest in specific programmes of research into any of the particular topics
- Development of sustainable development workgroups in each member-organisation to support the collation and review of information on specific topic areas, and subsequently address the means of ensuring that recommendations are adopted and implemented

Appendix 9

CIRIA's sustainable construction indicators

Introduction

This paper contains extracts from the report arising from CIRIA Project 609, Sustainable Construction: Company Indicators. Firstly, the paper lists a set of **sustainable construction issues**. Secondly, it tabulates **sustainability indicators**. To an extent, the relevance to individual companies of the sustainability indicators depends on the activities they engage in (ie *design & consultancy* or *construction* activities).

The lists overleaf (A,B,C & D) should be considered in accordance with the following classifications:

Sustainability indicator type		Activity	
		Design & Consultancy	Construction
Strategic	Environmental	A	A
	Social	A	A
	Economic	A	A
Operational	Environmental	B	C
	Social	D	D
	Economic	D	D

I SUSTAINABLE CONSTRUCTION ISSUES

Key Theme	Principal Issues
Effective protection of the environment	
Avoiding Pollution	Mitigation & management of pollution from site Transport planning
Protecting and enhancing biodiversity	Waste minimisation & management Habitat creation & environmental improvement Optimising use of brownfield sites Environmentally sensitive design and construction
Prudent use of natural resources	
Improved energy efficiency	Design for whole life costs Use of local supplies & materials with low embodied energy
Efficient use of resources	Re-use of existing built assets Lean design & construction Water conservation Use of recycled / sustainably sourced products
Social progress which recognises the needs of everyone	
Respect for staff	Provision of effective training & appraisals Equitable terms & conditions Provision of equal opportunities Health, safety and provision of a conducive working environment Maintaining morale and employee satisfaction Participation in decision-making
Working with local communities	Minimising local nuisance and disruption Building effective channels of communication Contributing to the local economy Delivering structures and buildings that enhance the local environment
Partnership working	Building long-term relationships with clients Building long-term relationships with suppliers Corporate citizenship Delivering buildings and structures that provide greater satisfaction, wellbeing and value to clients and users Contributing to sustainable development globally

II SUSTAINABILITY INDICATORS

A. Strategic Indicators

Environmental
<ul style="list-style-type: none">● Percentage turnover of company operations with a formal or independently certified Environmental Management System to ISO 14001 or equivalent● Percentage score calculated using the Business in the Environment (BiE) index of company environmental engagement● Percentage of projects for which an environmental assessment has been undertaken and proposed environmental mitigation measures implemented● Percentage of company sites operating under the Considerate Constructors or related scheme● Number of formal environmental or nuisance notices served due to construction activities● Percentage of services by value obtained from companies with a certified Environmental Management System to ISO14001 or equivalent● Percentage of projects for which standards of environmental performance and social engagement have been formally agreed with the client● Percentage of projects for which whole-life costs and/or Life Cycle Assessment have been calculated and used in the design of the project or in the method of construction and materials used
Social
<ul style="list-style-type: none">● Percentage of staff covered under the terms of an Investors in People or similar scheme● Percentage of annual staff turnover for permanent staff● Percentage of services by value obtained from companies operating an Investors in People or similar scheme● Reportable fatal and non-fatal accidents per 100,000 hours worked● Percentage of projects that include (and implement) a plan for stakeholder dialogue● Percentage of appropriate projects that include (and implement) a plan to consult with the end-user● Proportion of turnover generated by projects undertaken under alliances or other forms of partnership working● Average client satisfaction using the KPI approach
Economic
<ul style="list-style-type: none">● Profit before tax and interest as a percentage of sales● Profit before tax and interest per employee

B. Operational Environmental Indicators for Companies providing Design and Consultancy Services

Issue	Indicators
<u>Avoiding pollution</u>	
Identification of potential pollution sources and design of mitigation measures	Percentage of projects per £ turnover including: <ul style="list-style-type: none"> • Traffic management schemes during construction and use • Dust control • Noise controls • Measures to prevent ground contamination • Measures to prevent water contamination
Design for minimum waste in construction, use and afterlife	Percentage of projects with a waste minimisation strategy
Effective site supervision (where consultant is employed in a client resident engineer capacity)	Number of environmental or nuisance notices served due to construction activities per £ turnover
<u>Protecting and enhancing biodiversity</u>	
Design-in environmental improvements such as by landscaping	Cost of environmental improvements designed as a proportion of total project costs
Identification of opportunities to enhancing biodiversity by habitat creation	Percentage of project sites for which an assessment of existing biodiversity has been undertaken prior to design and appropriate mitigation measures implemented Area of habitat designed and created
<u>Efficient use of resources</u>	
Propose lean designs avoiding over-engineering	<i>No generic indicators – sector specific indicators are more appropriate</i>
Design for whole life-costs	Percentage of projects for which life-time costs have been derived and were a material consideration in the design
Specify use of recycled materials, or those from sustainable supplies or with low embodied energies	Percentage of secondary and recycled aggregate used in construction Percentage of timber used in construction from well managed, sustainable sources
Design to conserve water in use including, where appropriate, rainfall-capture and grey-water systems	Predicted treated water consumption for new buildings in litres per person per day (lpppd) averaged over all projects of a similar type Design capacity of grey-water and rainfall collection systems
<u>Improved energy efficiency</u>	
Energy efficient building design	Energy efficiency of the building design for domestic buildings – The average SAP rating for all dwellings designed

Energy efficiency of the building designs for non domestic buildings – Average % beyond building regulations (either for insulation levels of the building fabric or an overall energy target)

Percentage of projects (by turnover) incorporating renewable energy systems or combined heat and power

Reduced energy consumption in business activities

CO₂ emitted per £ turnover (DETR, 1999b)

Incorporation of renewable energy sources or combined heat and power schemes into development design

Percentage of energy demand by structure provided from:

- Renewable sources
- Combined Heat and Power

Generic

Percentage of projects (by turnover) for which the M4I index of project sustainability has been calculated. The average score of projects measured

Percentage of relevant projects (by turnover) for which a BREEAM score (or similar system) been calculated

Percentage of projects achieving an “excellent” rating using BREEAM (or similar system) for new construction projects

Percentage of projects achieving an “excellent” rating using BREEAM (or similar system) for refurbishment projects

C. Operational Environmental Indicators for Companies Providing Construction Services

Issue	Indicators
<u>Avoiding pollution</u>	
Minimising polluting emissions	SO ₂ , PM ₁₀ and NO _x released (in tonnes) per £ turnover arising from construction activities Average distance travelled per tonne of materials from suppliers to site (km)
Preventing nuisance from noise and dust by good site management	Number of complaints received per project site for noise and dust Proportion of construction costs on nuisance mitigation
Construction waste minimisation and elimination	Tonnes of wastes arising to landfill per £ turnover Tonnes of hazardous wastes arising per £ turnover
Preventing pollution incidents and breaches of environmental requirements	See Strategic Indicators
<u>Protecting and enhancing biodiversity</u>	
Protecting sensitive ecosystems through good construction practices and supervision	Percentage of project sites for which appropriate mitigation measures have been implemented to protect sensitive ecosystems Number of non-conformance certificates issued by £ turnover
<u>Efficient use of resources</u>	
Lean construction avoiding waste	Tonnes of unused construction materials disposed to landfill Percentage of materials intentionally over-ordered by value Percentage of recycled and secondary aggregate used in construction
Use recycled materials, or those from sustainable supplies or with low embodied energies	Percentage of timber used in construction from well managed, sustainable sources
Conserve water during construction	Water consumption in (m ³) per £ turnover arising from construction site activities
<u>Improved energy efficiency</u>	
Energy efficient construction processes	CO ₂ released (in tonnes) per £ turnover arising from construction activities (DETR, 1999b)
Reduced energy consumption in business activities	CO ₂ released (in tonnes) per £ turnover (DETR, 1999b) arising from business related non-site activities
Generic	Percentage of projects (by turnover) for which the M4I index of project sustainability has been calculated. The average score of projects measured

D. Operational Social Indicators

Key issues	Indicator
<u>Respect for staff</u>	
Provision of effective training and appraisals	Percentage of staff receiving formal annual appraisals
	Percentage of staff expressing satisfaction with the appraisal system
	Percentage of staff undertaking structured training programmes including social and environmental aspects of construction
	Percentage of staff time used for giving or receiving formal training including social and environmental aspects of construction
Equitable terms and conditions	Percentage of staff with a pension to which the company contributes
	Percentage of part-time workers
	Percentage of staff working with flexible hours
	Percentage of staff offered flexible benefits
	Percentage of staff working more than 48 hours per week
	Number of employees opted out of the Working Time Directive
	Percentage of employees declining offers of employment
Providing equal opportunities	Proportion of women employed
	Proportion of staff from ethnic minorities
	Proportion of staff registered disabled
	Proportion of women in senior management positions
Health, safety and provision of a conducive working environment	See Strategic indicators for health and safety
	Number of site employees provided with showers and rest areas in place of work
Morale and employee satisfaction	Percentage of staff involved in on-going surveys of job satisfaction
	Percentage of staff expressing satisfaction with the way the company treats them
Participation in decision making	Percentage of staff represented through Staff Consultative Committees
	Percentage of eligible staff taking-up share-save or similar schemes
	Percentage of company owned by employees
<u>Working with local communities</u>	
Minimisation local nuisance and disruption	See Strategic Indicators and Operational Environmental Indicators
	Number of complaints received about inappropriate behaviour from employees working on site
Building effective channels of communication	See Strategic Indicators
<u>Partnership working</u>	
Building long-term relationships with clients	Number of clients with whom long-term strategic alliances have been formally agreed

Key issues	Indicator
Building long-term relationships with suppliers	Number of suppliers with whom long-term strategic alliances have been formally agreed
Corporate citizenship	Value of charitable donation in money or time as a proportion of profits ¹

E. Operational Economic Indicators

Theme	Indicator
Improved project delivery	Average actual duration at Commit to Construct less the estimated duration at Commit to Invest, expressed as a percentage of estimated duration at Commit to Invest
	Average actual duration at Available for Use less the estimated duration at Commit to Construct, expressed as a percentage of the estimated duration at Commit to Construct
	Average actual cost at Available for Use less the estimated cost at Commit to Construct, expressed as a percentage of the estimated cost at Commit to Construct
	Average actual cost at Available for Use less the estimated cost at Commit to Invest, expressed as a percentage of the estimated cost at Commit to Invest
	Average condition of the facility with respect to defects at the time of handover for projects completed in 2000, using the 1 - 10 scale
	Average client satisfaction was with the finished product/facility, for projects completed in 2000, using a 1 to 10 scale
Increased profitability and productivity	The average normalised construction cost of a project in 2000 less the normalised cost of a similar project in 1999, expressed as a percentage of the normalised construction cost of the project in 1999
	Company value added per employee (£) reported in 2000 (Value added is turnover less all costs subcontracted to, or supplied by, other parties)
	Profit before tax and interest as a percentage of sales, reported in 2000

Appendix 10

Some potentially useful definitions on categories (provided for guidance only – these may need to be checked against original sources)

Extract from DTI Document (20 June Draft)

CATEGORIES OF NUCLEAR WASTE

Very Low Level Waste (VLLW) Covers wastes with very low concentrations of radioactivity. It arises from a variety of sources, including hospitals and industry in general. Because VLLW contains little total radioactivity, it can be disposed of safely with domestic refuse either directly at landfill sites or indirectly after incineration.

Low Level Waste (LLW) Includes metals, soil, building rubble and organic materials which arise principally as lightly contaminated miscellaneous scrap. Metals are mostly in the form of redundant equipment. Organic materials are mainly in the form of paper towels, clothing and laboratory equipment that have been used in areas where radioactive materials are used - such as hospitals, research establishments and industry.

Intermediate Level Waste (ILW) This is waste with radioactivity levels exceeding the upper boundaries for LLW but which does not need heating to be taken into account in the design of storage or disposal facilities. ILW arises mainly from the reprocessing of spent fuel, and from the general operation and maintenance of radioactive plant. The major components of ILW are metals and organic materials, with smaller quantities of cement, graphite, glass and ceramics.

High Level Waste (HLW) High Level Waste (HLW) is heat-generating waste that has accumulated since the early 1950s at Sellafield and Dounreay, primarily from the reprocessing of spent nuclear fuel. The temperature in HLW may rise significantly, so this factor has to be taken into account in designing storage or disposal facilities. As with ILW, there is currently no final management strategy for HLW.

BASIC GUIDE TO RADIATION AND RADIOACTIVE DECAY

There are several types of ionising radiation:

X-rays and gamma rays represent energy transmitted in a wave without the movement of material, just like heat and light from a fire. X-rays and gamma rays are virtually identical except that X-rays do not come from the atomic nucleus. Unlike light, they both have great penetrating power and can pass through the human body. Thick barriers of concrete, lead or water are used as protection from them.

Alpha particles have a positive electrical charge and are emitted from naturally occurring heavy elements such as uranium and radium, as well as some from man-made elements. Because of their relatively large size, alpha particles collide readily with matter and lose their energy quickly. They therefore have little penetrating power. However, if they are taken into the body, for example by breathing or swallowing, alpha particles can affect the body's cells. Inside the body, because they give up their energy over a relatively short distance, alpha particles can inflict more biological damage than other radiations.

Beta particles are fast-moving electrons ejected from the nuclei or atoms. These particles are much smaller than alpha particles and can penetrate up to 1 to 2 centimetres of water or human flesh. Beta particles are emitted from many radioactive elements. They can be stopped by a sheet of aluminium a few millimetres thick.

Neutrons are produced by the splitting, or fissioning of certain atoms inside a nuclear reactor. Neutron radiation is very penetrating and water and concrete are therefore used as protection against it.

All types of radioactivity decay over time in accordance with their half-life characteristics. The half-life is the time it takes for a given radioactive isotope to lose half of its radioactivity. After one half-life the level of radioactivity of a substance is halved, after two half-lives it is reduced to one quarter, after three half-lives to one-eighth and so on. The rate of decay of an isotope is inversely proportional to its half-life, i.e. radioactivity lasts longer if it has a long half-life.

Risk reduction is the fundamental consideration in waste management and decommissioning activities. Therefore the strategy for decommissioning a typical first generation reactor is based on the knowledge that, over time, the radioactivity within the reactor will decay naturally to a level that allows easier access, i.e. one where workers can enter wearing standard protective clothing and using simpler technology to demolish the structures. However, in some circumstances, especially where alpha contamination is involved, delaying decommissioning can result in levels of radioactivity increasing. In such cases, the imperative to reduce risk requires earlier action.

VLRM - Very Low Radioactive Material

Definition of VLRM

UKAEA has defined VLRM as lightly contaminated material containing <40Bq/g relatively short-lived beta/gamma and <1Bq/g alpha, both above background. The definition is restricted to construction wastes from decommissioning and contaminated soil and excludes organic or putrescible material.

Glossary of Terms

a. Radioactive Wastes

Legal definitions of radioactive material and radioactive waste are contained in Sections 1 and 2 of the Radioactive Substances Act (RSA '93); the effect of the definitions is that radioactive waste generally includes:

- i. scrap, surplus or spoilt radioactive material, and
- ii. any other waste substance or article which has become radioactive or has acquired an increased concentration of radioactivity

(Guidance on Requirements for Authorisation)

b. Waste Definitions

Activity

▲	ILW P15, Cl 53, Cm2919	Wastes with radioactivity levels exceeding the upper boundaries for low level waste but which do not require heating to be taken into account in the design of storage or disposal facilities.
<4GBq/te α <12GBq/te β/γ	LLW P16, Cl 53, Cm2919	Wastes containing radioactive materials other than those acceptable for disposal with ordinary refuse, but not exceeding 4GBq/te α or 12GBq/te β/γ activity (ie wastes which, under existing authorisations, can be accepted by BNFL at Drigg, or previously by UKAEA at Dounreay).
0.001GBq/te α 0.04GBq/te β/γ	VLRM (UKAEA classification)	Wastes containing less than 0.001GBq/te α or less than 0.04GBq/te β/γ
0.004GBq/m ³	VLLW P16, Cl 53, Cm2919	Wastes which can be safely disposed of with ordinary refuse (dustbin disposal), each 0.1m ³ of material containing less than 400kBq β/γ activity or single items containing less than 40kBq β/γ activity. (Note no α allowance)
< 0.0004GBq/te	Exempt	Materials which are exempt from regulation through SoLA or Schedule 1 exemption criteria.

c. Controlled Burial (p49, Glossary, Cm2919)

Authorisations are issued for the burial of some LLW at suitable landfill sites which have good contained characteristics. For example, if they have several metres of clay lining.

This controlled burial requires Authorisations under RSA93 and is intended for use by non-nuclear industries which process raw materials containing natural radioactivity, and by major hospitals and universities for their relatively more active waste streams, as well as by BNFL for waste from its uranium enrichment and fuel fabrication plants and for lightly contaminated excavation spoil at its Sellafield site. Usually, a site receives waste for controlled burial from no more than one or two sources. (p32, CI 114, Cm2919)

d. Very Low Radioactive Material (VLRM)

VLRM is defined as:

- lightly contaminated material containing up to 40 Bq/g of relatively short-lived $\beta\gamma$ activity and < 1 Bq/g long lived α activity.
- the classification is restricted to construction wastes from decommissioning (concrete, rubble, metal) and contaminated ground (soil, sand and rock). VLRM does not include organic waste such as paper or putrescible material.

This definition has been developed as a response to the NII/SEPA Safety Audit of Dounreay, Recommendation 81 the "UKAEA should develop and implement a strategy for the treatment and disposal of very low radioactive material".

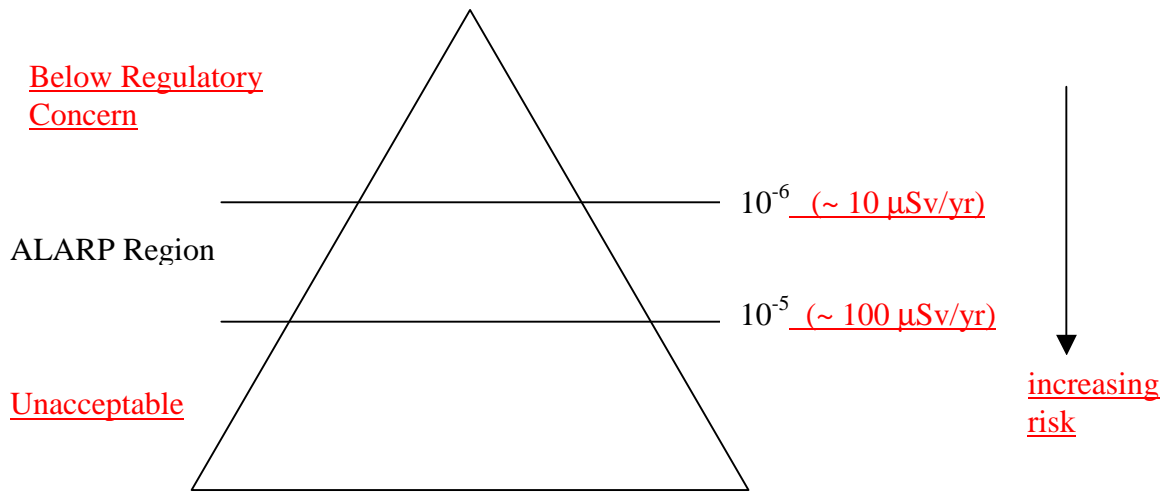
e. Exemption Levels

- Under the Substances of Low Activity (SoLA) Exemption Order 1986, solid materials containing man-made radionuclides are exempt from control if the activity is less than 0.4 Bq/g.
- Naturally occurring radioactive materials (NORM) are exempt if the radionuclide activities are less than those stated in the Radioactive Substances Act (RSA) Schedule 1 or one of the conditional exemption orders, such as the Phosphatic Substances, Rare Earths, etc. exemption order.
- Organic liquids containing up to 4 Bq/ml of carbon-14 and tritium are exempt. All other liquids containing man-made radionuclides are categorised as low level waste.
- Gases containing radionuclides and daughters with half-lives of less than 100 seconds are exempt.

f. Clean Materials

Clean materials are neither contaminated with radioactivity nor activated above background levels.

Basic Safety Standards (BSS) Waste Disposal Tolerability of Risk (ToR)



0.4Bq/gm is approximately equivalent to a 10^{-6} risk. However, different radionuclides have different radiotoxicities. An alternative method of implementing the European BSS Directive has been proposed by DEFRA, but not implemented, which would classify radionuclides into one of three bands with activity $<0.10\text{Bq/gm}$, $<1\text{Bq/gm}$ and $<10\text{Bq/gm}$. The table below indicates which radionuclides would fall within the different bands. The lowest band is more rigorous than the present limit, but is relatively easy to monitor. The higher bands would significantly reduce the volume of LLW in favour of the exempt category.

0.1 Bq/g	Radionuclides which emit gamma radiation or whose daughters emit gamma radiation with an energy $>0.5 \text{ MeV}$ (inc. Cs137, Cs134, Co60, Fe59)
1 Bq/g	Alpha emitters, most beta emitters and gamma emitters whose energy is less than 0.5 MeV (inc. Pu236, Pu238, Pu239, Pu240, Pu242, Am241, Sr90)
10 Bq/g	Low energy beta emitters and electron capture (inc. H3, C14, Pu241)

Appendix 11

Process options for VLLW dialogue (Tabled at meeting PSG meeting 3)

This paper (which was written by The Environment Council following a meeting with CIRIA to discuss the outcomes of the stakeholder workshop 16 October 02) contains two options for this dialogue and a list of issues that have been identified so far. Timings are outline only.

A decision needs to be made about the initial approach to this dialogue. One way would be to consider the issues of on-site use of materials first and then to consider the off-site issues. Much of the work done on on-site issues would inform the off-site work.

Option one - A traditional dialogue approach

11.02 to 12.02	Final scoping report produced To include dialogue proposals and costings		
11.02 to 1.03	Funding Securing funding for dialogue. (Note – RMC EF no longer an option. Other LTC schemes?)		
1.03 to 3.03 2.03 to 4.03	<p>Steering Group Set up the group as per meeting proposition on 17.10.02. To include – Sustainability expert/ NGO/ CBO/ Nuclear industry/ regulator/ user of recyclates/ demolition industry/ material disposers/ academic/ local authority / government</p> <p><i>Broad tasks to –</i> oversee process/ address inclusion issues/ address methodological issues/ communication issues/ oversee budget etc.</p> <p><i>Specific tasks –</i> Set up next main meeting/ explore Citizens Jury/ electronic consultation/ indicator work proposal for main meeting/ quantification work proposal</p> <p>Possible sub-groups, if necessary</p>		
3.03 to 5.03	<p>2nd main group Large group meeting with wider range of stakeholders (see 17.10.02 proposals)</p> <p>Agree/amend papers from Steering Group on way forward to include – Sustainability indicators/ quantification/ radioactivity issues</p> <p>Agree/amend Steering Group to – Manage way forward/ Citizen’s Jury/ Electronic consultation</p>		
6.03 to 9.03	Working Groups Meet two or three times	Steering Group Meets two or three times	Citizen’s Jury On theme to be decided by 2 nd main group
9.03 to 11.03	<p>3rd main group To process recommendations from Working Groups/ Steering Group and Citizen’s Jury Agree next steps</p>		
9.03/11.03 onwards	Next steps as necessary		

Process issues

For this to be a deliberative process all the participants need to be informed about the issues discussed. A task for the initial Steering Group will be to produce information for participants in plain language and for the first meeting to have the space for people to get a short briefing from different perspectives (industry/regulator/ngo for example).

The initial main meeting did not attract the range of stakeholders that would be needed to run this in the usual manner. This can be addressed, to some extent, by using wider web-based consultation and devices like a Citizens Jury; but this means that the whole range of opinion does not engage in live, spoken dialogue.

A Project Group (The Environment Council, CIRIA, facilitator) will meet occasionally to review process issues.

Option two – Stakeholder Group

11.02 to 12.02	Final scoping report produced To include dialogue proposals and costings
11.02 to 1.03	Funding Securing funding for dialogue. (Note – RMC EF no longer an option. Other LTC schemes?)
1.03 to 2.03	1st Steering Group (Stakeholder Group) Set up the group as per meeting proposition on 17.10.02. To include – Sustainability expert/ NGO/ CBO/ Nuclear industry/ regulator/ user of recyclates/ demolition industry/ material disposers/ academic/ local authority / government
2.03 to 3.03	Group meets to – Oversee process/ address inclusion issues/ address methodological issues/ communication issues/ oversee budget etc. <i>Specific tasks –</i> Explore use of Citizens Jury and electronic consultation Consider indicator work proposal and quantification work Produce a working definition of sustainability and produce a working definition of consensus Group to invite ‘experts’ as and when necessary.
3.03 to 5.03	2nd Stakeholder Group Agree/amend papers from on - Sustainability indicators/ quantification/ radioactivity issues Agree/amend way forward on Citizen’s Jury and Electronic consultation
5.03 to 7.03	3rd Stakeholder Group To process feedback from Electronic consultation/ Citizen’s Jury Agree next steps
9.03/11.03 onwards	Next steps as necessary 2 to 3 more Stakeholder Group meetings. Extended consultation, document preparation, publication etc.

Process issues

The Stakeholder Group would overcome the issue of sectoral representation and would, potentially, be able to work quicker than a traditional process. Each member would be responsible for liaising with their constituents.

The NGO and CBO members may need to be paid for attendance and to have meetings with their wider constituents resourced (and facilitated, if they wish).

The Stakeholder Group may also meet in workshops with 'experts' in various fields to enhance their decision making.

A Project Group (The Environment Council, CIRIA, facilitator) will meet occasionally to review process issues.

Issues

- Radioactivity levels (using >4Bq as guideline) and amending classification in context of EU work
- Sustainability indicators
- Deconstruction indicators
- Quantification issues
- Re-use/recycling issues
- Links to other decommissioning initiatives and SAFEGROUNDS
- Links to other work eg HSE consultation
- Advocacy issues eg clarifying regulation, lobbying for new legislative framework, LMA/LMU
- LLW/ILW/HLW waste issues in future
- Consensus – working definition
- Risk assessment
- Fit for purpose
- Public acceptability
- Access to dialogue – knowledge issues and capacity of NGO/CBO reps (because not paid or don't have time)
- On site issues and off site issues

Appendix 12

Photo report transcription

Establishing sustainable practices in managing Very Low Level Waste (VLLW) and free-release construction materials in nuclear industry decommissioning

16 October 2002

Report

8th November 2002

Please note

This report is a transcription of the flipcharts recorded at the meeting.

We have added process comments in grey boxes to explain the context and aid understanding.

Produced by The Environment Council

The meeting was designed and facilitated by Carl Reynolds of Carl Reynolds Associates, Lucy Parnall of The Environment Council and independent facilitator Carey Haslam.

If you have any comments or queries regarding this report please contact:

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E-mail: lucyp@envcouncil.org.uk

Attendees

	Organisation
Mr Dave Bennett	Environment Agency
Mr Adam Bradbury	BNFL
Mr Richard Bramhall	Low Level Radiation Campaign
Ms Natalie Christou	Atomic Weapons Establishment Plc
Mr Simon Clark	Ministry of Defence
Dr Andrew Cooney	BNFL
Mr Robert Dudgeon	Highways Agency
Prof Peter Guthrie	University of Cambridge
Mr Anthony Hart	BNFL
Mr Paul Hughs	Environment Agency
Dr George Hunter	Scottish Environment Protection Agency
Mr Jeff Kersey	Construction Industry Research & Information Association
Mr Nigel Lawson	University of Manchester & UMIST
Mr Mark Liddiard	UKAEA
Mr George Linekar	UKAEA
Mr R Matthews	UKAEA
Mr David Owen	BNFL
Mr John Pell	Cumbria County Council
Ms Deb Potter	Atkins
Mrs Joyce Rutherford	Health & Safety Executive
Ms Rachel Smith	National Radiological Protection Board
Dr Graeme Stonell	UKAEA
Mr Rob Storrie	Amersham Plc
Facilitation Team	The Environment Council
Mr Carl Reynolds	
Ms Lucy Parnall	
Ms Carey Haslam	
Ms Jayne Cordner	

1. Status of this report

The Environment Council has compiled this record of the workshop without interpretation. Comments were made by the facilitators on flipcharts and aimed to give an overall sense of what was said during discussions, they are not a verbatim record. The main points were recorded and summarised, frequently at high speed and participants had the opportunity to add or correct anything that was written.

The flipcharts have been transcribed for the main body of the report and have not been edited in any way (please see appendix 1 for photoreport)

To help make this report intelligible, explanatory notes have been added in italics and put in shaded boxes, such as this, by the facilitator.

2. Objectives, Agenda and Ground rules for the Meeting

At the beginning of the day the group agreed the following objectives, agenda and groundrules.

Objectives

- Inform you about this project
- Explore your response
- Agree the main areas to focus on
- Agree a way forward

Agenda

10:00 Introduction

10:30 Speakers

George Linekar, UKAEA

Jeff Kersey, CIRIA

Peter Guthrie, Cambridge University

11:20 What are the issues?

11:50 Break

12:10 What are the key issues?

12:50 Addressing the issues

13:30 Lunch

14:15 How to take this project forward

15:15 Break

16:00 End

Ground Rules

- Mobiles and pagers off
- One person speaks at a time
- Engage with a spirit of inquiry, not defensiveness
- Identify confidential issues during the day
- Non-attribution

3. Presentations

Presentations were made on the preliminary work and scope of the project

- *George Linekar, UKAEA spoke about the background to the project*
- *Jeff Kersey, CIRIA spoke about sustainability indicators*
- *Peter Guthrie, University of Cambridge spoke about the initial quantification work at Dounreay*

Participants could then ask questions of clarification.

All slides from the presentations can be found in appendix 2 . CIRIA's list of sustainability indicators can be found in appendix 3.

Questions on George Linekar's Talk

- At Dounreay background levels approx 1 Bq/g α , β , γ
- Levels for VLLW are *approx* 4 times background at Dounreay
- Background levels vary across the country
- Alpha levels for exempt materials were thought to be 0.4 Bq/g for exempt waste by some people, as well as β and γ
- Keep an eye on DEFRA re-definitions
- There is some disagreement about the classification
 - It should be labelled as material in the lower end of LLW, not VLLW
- LLW is a very large category
- Large volumes of construction wastes will be produced in decommissioning
- Dialogue to explore the options for dealing with large volumes of Low Level Waste materials
- Could have a clearance category
- Exempt materials are still classified as radioactive
- Demolition wastes are mentioned in 1982 document which suggests controlled burial is a disposal option under authorisation
 - Don't think demolition wastes are mentioned in 2919

Questions on Jeff Kersey's Talk

- Some companies involved in pioneers club are also involved in nuclear sites
- If want to continue indicators work would come up with a specific set of indicators for this project
- Would be better to have more specifically designed indicators for this project
- Need to make sure indicators are meaningful, collectable and robust
- Indicators do not currently cover deconstruction
- Need to consider deconstruction indicators in this project
- The indicators presented were developed for the construction industry
 - Don't think that brownfield sites are covered
- Need to consider brownfield sites in this project

Questions on Peter Guthrie's Talk

- In construction industry, conventional risk is well understood but there are no actual values
- UKAEA have approached risk in term of future scenarios
- On conventional construction sites concrete has a high potential for re-use
- Concrete at D is a very high quality so there could be some local re-use but transport would be an issue for further re-use (economic factor)
- The material could be re-used on D site for high amounts of material
- Construction storage for ILW would need a lot of shielding which re-use aggregates could be used
- For nuc. site economics might be different and shouldn't discount opportunities as could be subsidied
- Need to identify assumptions and test them

Overall Comments on Issues

- Desire to re-use if possible but cost issues considered
- Need to consider VLRM category
- Need to do a task *based* risk assessment on levels
 - Level may be different for different options
- Original idea was to look at one category of waste, methodology could then be more widely applied

4. What issues should be discussed?

Participants worked in small mixed groups at their tables to identify their 3 key issues these were then reported back in a plenary session and recorded. Four overarching themes were identified after some discussion about groupings. An attempt was made to attribute each issue to a grouping, but this was abandoned as it was felt that all issues needed to be considered under each grouping.

Groupings

- 1) Fate of construction material
→ possibilities
- 2) Environmental impacts
→ inc. radioactive issues
→ impacts of the possibilities of 1
- 3) Influencing wider contexts
→ Government, implementation
- 4) Process

Issues

- Environmental impact of current disposal technology
- How do you practically characterise materials? (Physical)
- Long-term disposal strategies
- Definitions of characterisation of radioactive waste – are they suitable for this project?
- How does this actively relate to the bigger picture – Government strategy on waste
- Potential use, re-use of recycling options and disposal options and minimisation option
- Risk assessment should look at whether fit for purpose

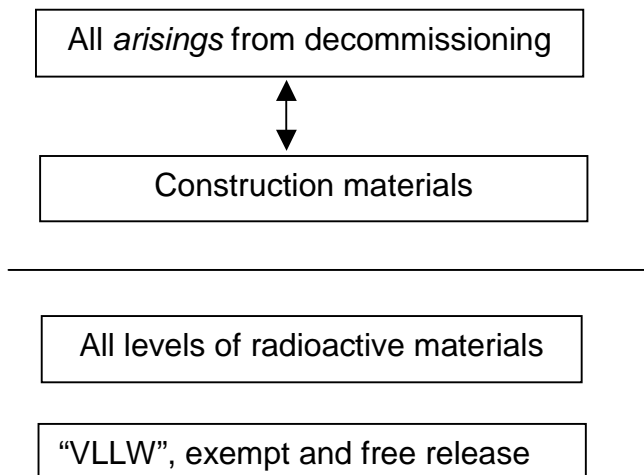
Effect on human health? radioactivity ? the environment – pay attention to work going on and continuing to go on with particular attention to assumption that 0.4 Bq/g is appropriate level

- Acceptability of organisations that may accept material off site
- Highlight inconsistencies in Government policy and implementation
→ How can this group add to other consultations and dialogues
- Public acceptability of proposed options overarching
- Consistent with best practice elsewhere overarching
- Whoever is involved represents as broad a span as possible
- Participants in process are well informed and can make sound decisions
- Implications of lack of strategy and its affect on other programmes
- Ability to characterise material in terms of likely end-use (analytical and sampling process emphasised) radiological
- Long term reuse of materials needs to be compatible with long-term use of site
- Artificial and naturally occurring radioactivity in the context of background levels. Need to take account of speciation, environmental pathways and health context
- Demonstrable and enacted sustainable practices – to go beyond the bare minimum
- Drigg – how appropriate is it that material at very low end to go to Drigg? Appropriate degree of control

- Consider whole life cycle of material not just first re-use
- Our deliberations should not just consider Dounraey
- Work needs to be timely but not rushed
- Criteria for acceptable risk or acceptable basis for processes proposed
- Defining when material becomes waste
- Re-use materials as part of waste treatment
 - e.g. use as grouting when dealing with LLW and HLW

5. What is this dialogue be about?

There was some discussion about what the dialogue should address. Two themes emerged - 1) what type waste should it consider, and 2) what level of radioactivity. These were represented as two continuui.



What is this process about?

- Start with “VLLW” and then move onto other wastes
- “VLLW” an issue for the industry as will “constipate” decommissioning due to large volumes
- Define “VLLW” – 4 Bq/g and look at this
- There needs to be strategies for all waste
- Want to address VLLW and exempt material as they have been excluded from current Government consultation
- Difficult to apply exemption orders on some wastes
- Fundamental problem with picking a number, need a process
 - Could define the materials, look at the options and do a risk assessment process
- Trying to introduce a new category for the lower end of LLW
- In Europe have different levels for different radionuclides

The group agreed that the process should focus initially on waste that had radioactivity levels of equal to or less than 4 Bq/g, but look at different levels for some radionuclides as work progresses. And that a “fit for purpose” approach

- HSE (to become HSC) will be publishing a consultation doc on delicensing criteria later in the year
- In the 2nd phase of work need to look at impact of waste in its new form
- Need to prioritise material and look at large volume materials first
- Look at all options

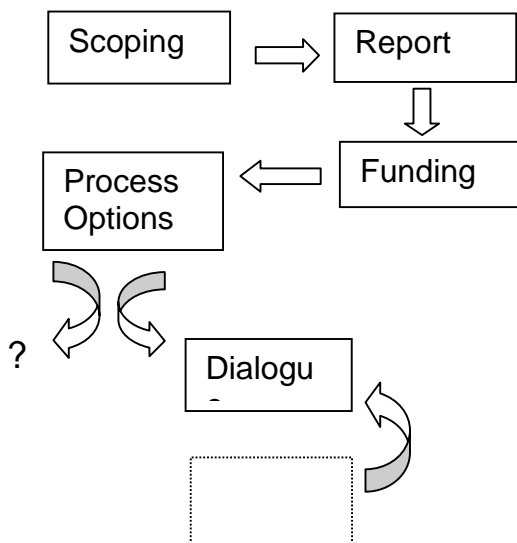
- Re-use, minimisation, waste disposal etc
- If someone takes the material will probably be registered legally to hold them
 - Custodian

6. Way forward for the dialogue

The group discussed possible ways forward for the dialogue, representation, funding and information needs.

The process diagram shows the way forward from now. We are currently in the scoping phase. The output of this phase will inform CIRIA's report on the best way forward and funding will then be sought. The future process could be a traditional stakeholder dialogue or another form of stakeholder engagement.

Possible Process



Who else needs to be involved?

- Nirex
- LMU/A
- People who might buy or use material
- Greenpeace, FoE, other bodies with overarching responsibility for environment
- BRE
- People who are registered legally to hold materials
- Royal Commission for Environmental Discharges
- Citizens' Jury – representatives of people without overt agendas
- Consumers' Association
- Ethical specialist
- Academic in social construction of knowledge (Brian Wynn, Ian Welsh, P. Dorfman)
- Plant managers
- Landfill operators
- NFLA
- DEFRA, DTI (were invited)
- Small Users Liaison Group (Scotland) / Small User Group (England)
- Federation of Demolition Contractors
- Drigg – Jeff Shaw
- EU –DG Environmental Luxembourg

- RTPI
- LAs in proximity of sites
- CORE
- Expertise from SAFEGROUNDS process?

Comments

- If can't/won't attend find other ways to keep them informed
- SAFEGROUNDS Guidance contains section on stakeholder involvement and difficulties facing NGOs and CBOs (www.safegrounds.com)
- Resourcing a big issue in NGO and CBO attendance
- Look at possibility of paying NGO representatives (more than expenses)

Steering Group membership

- A sustainable expert (Forum for the Future, University of Manchester)
- NGO
- CBO
- Nuc. Industry (Liabilities Management Group or Clearance and Exemptions Group)
- Regulator
- Potential user of recycled material (e.g. HA? Or BRE)
- People who deconstruct (Federation of Demolition Contractors)
- People who dispose of material (landfill operators)
- Academic?
- Local Authority / LGA / NFLA
- Government (DTI/DEFRA)

Comments

- What information needs to be or can be fed into the process?
- How to ensure other people who may be affected are included
 - Where is it going to end up?

Potential Funding

- Landfill tax credit scheme
- Industry
- Sustainability fund (WRAP for DEFRA)
 - Separate allocation for Scotland
- Partners in Innovation (DTI yearly funding)
- Joint industry funding

7. Evaluation

Each participant was given a sticky dot to put on each evaluation scale to show their reaction to the day. A few comments were then invited from participants and recorded.

How happy are you with the outcome of the day?

Comments

- Didn't have a briefing for the day – additional briefing that expanded on subject before arrived
- Contradiction between the 2 evaluations – fear concerns will not get carried through to the next stage because who will represent concerns and because of the sheer complexity and difficulty
- Not confident that we will get a sustainable approach – huge and intractable, what is sustainable? Power imbalance between lobbies, but outcome of day a good stab
- Encouraging to have group discussing industry therefore cost of not looking at the issues

How confident are you that the process outlined can deliver a sustainable approach?

Comments

- Putting sustainable development on the agenda
- So many agendas and hidden agendas can't be confident of the outcome
- Not sure about definitions being used
- Gut feeling – not confident
- If one of these materials gets used that's better than landfilling it
- Someone has to start

Appendix 13

Guidance on Regulation of Very Low Level Waste and Free Release Material under the Radioactive Substances Act 1993, as amended.

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1. Introduction

This paper confines itself to those Acts and regulations relating to radioactive materials/wastes in solid form and that are enforced by the Environment Agencies. It is to be noted that in some circumstances regulations enforced by the Health and Safety Executive, the Office of Civil Nuclear Security and the Radioactive Materials Transport Division of the Department for Transport need to be considered.

The main instruments controlling the keeping and use of radioactive materials and the accumulation and disposal of radioactive wastes are the Radioactive Substances Act 1993 (RSA 93), and related Exemption Orders. Schedule 1 of the Radioactive Substances Act 1993 (RSA 93) was originally Schedule 3 of the Radioactive Substances Act 1960 (RSA 60) which came into force in 1963. There had been an earlier Radioactive Substances Act 1948 introduced by the Minister of Health and this was mainly for the control of exposure, although there was a Schedule equivalent to Schedule 3 of RSA60. In 1960 Notes on Clauses for Ministers were produced, but these are not readily available and contain no reference to waste categories, however, the boundary between radioactive waste and non-radioactive materials was described by the use of Schedule 3 for eight natural radioelements. Any material rendered radioactive by artificial means (with no threshold) was to be classified as radioactive material necessitating registration. A general power for the Minister to exclude particular descriptions of waste from the authorisation procedure either absolutely or subject to limitations or conditions was described under Clause 6, subsection 5.

Why the delay between 1960 and 1963 for the Act to become operational? This was due to staff shortages in the Ministry, the need to make necessary exemptions needed to allow commerce/farming to proceed without undue hindrance, and to allow time for the users of radioactive materials to comply with the Acts requirements. .

This paper examines the guidance available on regulations on “free release” material and Very Low Level Waste (VLLW) under RSA 93 as requested, it considers first the lowest concentrations of radionuclides related to “free release” and then moves to higher levels of radionuclide concentrations. It is to be noted that there is no UK legal definition of free release. The excellent book by Stephen Tromans and James Fitzgerald on the law of radioactive substances makes no mention of “free release” or “clearance” . As you go through the paper you may find it useful to consult the last table (Table 6) which shows the development of some relevant UK regulations over the last 50 odd years

2. Role of Schedule 1

With regard to the lowest concentrations of radionuclides that constitute a radioactive waste, it is possible that Schedule 1 of RSA93 and the Substances of Low Activity Exemption Order (SoLA) and other Exemption Orders (EOs) are not being applied consistently. In the light of the long time period since becoming law and advances in science and technology, it was felt necessary recently to provide an interpretation of how Schedule 1 and SoLA should be used. Marion Hill and myself gave this interpretation in a Department of the Environment, Transport and the Regions report DETR/RAS/00.003. This paper draws heavily on that report but also on other work on EOs by Marion Hill (DETR/RAS/98.004) and Alan Martin (DETR/RAS/99.015).

Schedule 1 of RSA 93 gives the definitions of radioactive material and radioactive waste. RSA 93 Section 1(1) states "In this Act "radioactive material" means anything which, not being waste, is either a substance to which this subsection applies or an article made wholly or partly from, or incorporating, such a substance." Section 1(2) states "Subsection (1) applies to any substance falling within either or both of the following descriptions, that is to say, -

- (a) a substance containing an element specified in the first column of Schedule 1, in such a proportion that the number of Becquerels of that element contained in the substance, divided by the number of grams which the substance weighs, is a number greater than that specified in relation to that element in the appropriate column of that Schedule [**note there is no mention of additivity over several elements**];
- (b) a substance possessing radioactivity which is wholly or partly attributable to a process of nuclear fission or other process of subjecting a substance to bombardment by neutrons or to ionising radiations, not being a process occurring in the course of nature, or in consequence of the disposal of radioactive waste, or by way of contamination in the course of application of a process to some other substance."

In Section 2 it states "In this Act "radioactive waste" means waste which consists wholly or partly of -

- (a) a substance or article which, if it were not waste, would be radioactive material, or
- (b) a substance or article which has been contaminated in the course of the production, keeping or use of radioactive material, or by contact with or proximity to other waste falling within paragraph (a) or this paragraph"

Table 1 shows the concentrations in Schedule 1 of the eight main naturally occurring radioelements of the actinium, uranium and thorium series.

Table 1 Radioelement concentrations in Schedule 1

NOT APPROVED DEFRA POLICY GUIDANCE

Element	Bequerels per gram (Bq/g)		
	Solid	Liquid	Gas or Vapour
1. Actinium	0.37	7.40×10^{-2}	2.59×10^{-6}
2. Lead	0.74	3.70×10^{-3}	1.11×10^{-4}
3. Polonium	0.37	2.59×10^{-2}	2.22×10^{-4}
4. Protactinium	0.37	3.33×10^{-2}	1.11×10^{-6}
5. Radium	0.37	3.70×10^{-4}	3.70×10^{-5}
6. Radon	--	--	3.70×10^{-2}
7. Thorium	2.59	3.70×10^{-2}	2.22×10^{-5}
8. Uranium	11.1	0.74	7.40×10^{-5}

When drafting RSA 60, it was appreciated that materials containing low concentrations of naturally occurring radionuclides are ubiquitous and that, in order to avoid unnecessary and unmanageable administrative problems, levels needed to be specified below which RSA 60 would not apply. The concentrations for materials in solid form are, in the case of uranium, the level below which it would not then have been profitable to mine uranium ores. For the other radioelements the levels were such that if a person were to be in contact with the substance for a lifetime, they would not receive a dose of radiation exceeding the natural background. In the 1960s, although other minor natural actinium, uranium and thorium series radioelements were known to exist they were not included in Schedule 1.

Since 1960, the accepted radiological criteria have changed considerably and, for solid radioactive materials/waste the concept of "clearance" has been introduced internationally, but not directly into UK legislation. Schedule 1 sets out the concentrations of seven radioelements in solid materials below which these materials are for the purpose of RSA 93, not considered to be radioactive i.e. such material is excluded from regulation under RSA 93. Within the current UK framework the Schedule 1 values could also be viewed as unconditional clearance levels. Such clearance levels allow the unrestricted disposal, re-use or recycling of any volume of solid materials, with no further control once the material leaves the originating facility or practice being regulated. The Revised 1996 Basic Safety Standards (BSS) Directive sets down, amongst many other things, clearance criteria and was mainly implemented in the UK in 2000, partly by means of RSA 93.

The three issues on which guidance is now provided are in connection with the application of Schedule 1 and the definition of radioactive waste. These are:

- (i) Use of measurements of radionuclide concentrations in wastes to determine radioelement concentrations for assessing compliance with Schedule 1;
- (ii) The treatment under RSA 93 of natural radioelements that are not included in Schedule 1;
- (iii) The treatment under RSA 93 of radionuclides that occur both naturally and artificially.

These are detailed in Hill, M.D et al , 2000 but are summarised below.

3. Use of measurements of radionuclide concentrations in wastes to determine radioelement concentrations for assessing compliance with Schedule 1

3.1 Need for interpretation/guidance

The radioelements specified in Schedule 1 are the **major** ones in the actinium, uranium and thorium decay series. As can be seen from Figures 1-3, the series are complex and contain other but minor naturally occurring radioelements. Table 2 illustrates the overlap of the three series, and the relative abundances, and the conventional split between the **major** and the **minor** (and relatively short lived) radionuclides.

Table 2 Natural abundance (by activity) of radionuclides in the actinium, uranium and thorium series

Major radionuclides	Relative abundance (by activity) of major radionuclides cf. total radioelement	Minor radionuclides i.e. relatively short-lived daughter products
Actinium and uranium series		
U-234	0.489	
U-235	0.022	
U-238	0.489	
Th-227	0.023	
Th-230	0.477	
Th-231	0.023	
Th-234	0.477	Pa-234m
Pa-231	0.046	
Pa-234	0.954	
Ac-227	1	Fr-223
Ra-223	0.046	Rn-219, Po-215
Ra-226	0.954	Rn-222, Po-218, At-218
Po-210	1	
Bi-210	0.5	
Bi-214	0.5	Po-214
Pb-210	0.489	
Pb-211	0.022	Bi-211, Po-211, Tl-207
Pb-214	0.489	
Thorium series		
Th-228	0.5	
Th-232	0.5	

NOT APPROVED DEFRA POLICY GUIDANCE

Ac-228	1	
Ra-224	0.5	Rn-220, Po-216
Ra-228	0.5	
Bi-212	1	Po-212, Tl-208
Pb-212	1	

The major radionuclides are considered explicitly in most dose assessments. The minor radionuclides are usually assumed to be present in secular equilibrium with the major radionuclides (i.e. it is assumed that short-lived daughter products are present in the same concentration as their long-lived parents). When estimating external doses the minor radionuclides are considered explicitly. For doses via ingestion and inhalation it is usually assumed that only the parent radionuclide is taken into the body. Once inside the body, the effect of any in-growth of daughter products that occurs is included implicitly via the dose per unit intake factors for the parent radionuclide.

It is not possible or necessary, on a routine basis, to make all the measurements on samples of substances that would be needed to determine activity concentrations of every radioelement or radionuclide in the series, or even of the eight radioelements of Schedule 1. What is usually done is to measure the activity concentrations of main radionuclides or radioelements and infer the activities of others, using the assumption of secular equilibrium. The measured and inferred concentrations of radioelements are then compared to their levels in Schedule 1 to find out whether the substance is radioactive or not within the terms of RSA 93.

The different aspects of the guidance on radionuclide/radioelements are discussed in turn.

3.2 Proposed guidance for solid materials

To give guidance on inference and comparison it is necessary to consider how levels, which are in terms of radioelement concentrations, can be derived. The main question is how the minor radionuclides are to be dealt with. Every radionuclide of each radioelement must be considered in deriving the levels, but for the minor radionuclides there is a choice as to whether this is done explicitly or implicitly. This in turn has implications for application of the levels. It has been determined (see DETR 2000) that on the whole, a method in which only the longer-lived radionuclides are considered explicitly would lead to similar or lower doses than a method in which all but the very short-lived radionuclides are considered explicitly. The latter method has been shown to be consistent with meeting the radiological criteria for clearance in the Revised BSS Directive (see DETR et al 1999), so the former method would be consistent with the Revised BSS Directive too. Also, the longer-lived radionuclide method could mean that smaller quantities of ubiquitous solid materials of natural origin would come within the requirements of RSA, and hence place a lower burden of effort and cost on regulators and those regulated.

In the light of the above the "longer-lived radionuclides only" method should generally be used in assessing compliance of solid materials with Schedule 1. In this method the radionuclides whose measured or inferred concentrations are summed for comparison with the Schedule 1 radioelement concentration levels are as shown in Table 3. The use of other methods, involving summing of concentrations of long and short lived radionuclides cannot be ruled out entirely and might be necessary for materials containing unusual mixtures of radionuclides in the natural decay series. In such exceptional cases, users should check with their relevant Environment Agency office in order to agree an alternative method.

Table 3 Proposed guidance on use of radionuclide concentration levels for solid materials for assessing compliance with Schedule 1 radioelement levels

Schedule 1 radioelement and concentration (Bq/g)	Radionuclides whose activity concentrations (measured or inferred) are to be summed for comparison with Schedule 1 radioelement level	
Uranium	11.1	U-238, U-235, U-234
Protactinium	0.37	Pa-231
Thorium	2.59	Th-232, Th-230, Th-228
Actinium	0.37	Ac-227
Radium	0.37	Ra-226, Ra-228
Polonium	0.37	Po-210
Lead	0.74	Pb-210

A practical example of the use of this guidance is given below. A material was analysed and found to contain the radionuclides set out in Table 4.

Table 4 Worked example

Radionuclide/ radioelement	Radionuclide concentration (Bq/g)	Radioelement concentration divided by relevant Schedule 1 value	Quotient for radioelement
U-238	3		
U-234	3		
U		$(3 + 3) / 11.1$	0.54
Th-230	3		
Th-228	0.05		
Th		$(3 + 0.05) / 2.59$	1.18
Ra-226	1		
Ra-228	0.05		
Ra		$(1 + 0.05) / 0.37$	2.83
Pb-210	1		
Pb		$1 / 0.74$	1.35

It can be seen that in the case of thorium, radium and lead each radioelement quotient is greater than 1. Hence the material is clearly classified as radioactive material even without recourse to further analysis for the radionuclides uranium-235, thorium-232 and protactinium-231 which are inevitably present.

Another example would be a material containing 10 Bq/g of natural uranium metal, the refining and smelting process having removed the decay products. The uranium-238 and uranium-234 components would each equate to about 5 Bq/g and they would be in secular equilibrium with 5 Bq/g each of thorium-234 and protactinium-234m. In addition there would be a small activity and mass component from uranium-235. Using the longer-lived radionuclides only method, the concentration to be compared with Schedule 1 is that of the radioelement uranium. Since 10 is less than 11.1 Bq/g the material is not radioactive for the purposes of RSA 93.

4. The treatment under RSA 93 of natural radioelements that are not included in Schedule 1

Schedule 1 only lists eight of the radioelements in the natural uranium and thorium chains. The missing radioelements of the uranium and thorium chain include thallium, bismuth, astatine and francium, however, these have not arisen as problem radioelements in living memory of Radiochemical Inspectors and specifying levels for them in Schedule 1 have not been found to be necessary. Additionally 12 natural radionuclides are known in the lighter isotopes between potassium-40 and platinum-190. All these natural radionuclides are primordial and hence have very long half lives and low specific activities. They are not amenable to control in the conventional sense and they constitute only minor components of the variable natural background.

The principal natural radioelements, contributing to the natural radiation background from the earth's crust and natural building materials, that do not appear in Schedule 1 and that are not produced in appreciable quantities by human activities are potassium and rubidium. The isotopes of interest are potassium-40, which has a half-life of about one billion years, and rubidium-87, which has a half-life of about 50 billion years.

Potassium-40 occurs throughout the natural environment, wherever natural potassium is present, including in human body tissues. The average annual doses from potassium-40 in the body are 170 μSv per year (Hughes 1999). Doses from potassium-40 in building materials range from about 100 μSv per year to over 2,000 μSv per year (Mustonen et al 1997). In most circumstances it is impossible to control these doses because of the ubiquity of potassium-40, and it is unnecessary to do so. This is probably why potassium does not appear in Schedule 1. This is consistent with the Revised BSS Directive, because its Article 2 excludes from control exposures due to natural levels of radionuclides in the human body. The Article also excludes exposures from natural radiation sources unless the materials have been processed in view of their radioactive, fissile or fertile properties, or are involved in work activities where doses are significantly above normal background levels.

The situation is similar for rubidium-87. This radionuclide occurs in many rocks and soils, and in trace quantities in humans and other organisms. Doses from it are of the order of 6 μSv per year (Hughes 1999) and it is neither possible nor necessary to control them. Exclusion of rubidium from Schedule 1 is both appropriate and consistent with the Directive.

Another naturally occurring radioelement that is not included in Schedule 1 is samarium. This has three radioisotopes that occur in nature: samarium-146, -147 and -148. All have very long half-lives (more than 100 million years) and are alpha emitters. Samarium is only present in appreciable concentrations in a few rocks and minerals (for example, monazite that also contains the more radioactive element thorium). It gives rise to negligible doses to most people in most circumstances where wastes are handled.

Air contains naturally occurring radionuclides such as tritium, beryllium-7, and carbon-14 continuously produced by cosmic rays. The short half-life of beryllium-7 (53.3 days) means that little of it is incorporated in solids. The half-lives of the tritium (12.3 years) and carbon-14 (5730 years) mean that they are usually present in detectable levels in most solids. Doses from these radionuclides are low (of the order of 10 micro Sieverts per year, see Hughes 1999) and it is not possible to control them. Probably for these reasons, RSA 60 made no mention of these radionuclides in Schedule 3, they are not listed in Schedule 1 of RSA 93 and wastes containing only natural levels of such radionuclides are not regulated under RSA. This is consistent with Article 2 of the Directive. Materials containing

artificially enhanced levels of such radionuclides are addressed in Section 5.2 below.

5 The treatment under RSA 93 of radionuclides that occur both naturally and artificially

5.1 Radionuclides in the actinium, uranium and thorium series

Many radionuclides in the actinium, uranium and thorium series occur both naturally and artificially. Schedule 1 of RSA 93 applies to these radionuclides independent of their origin, thus depleted and enriched uranium is covered.

5.2 Other radionuclides

The other principal radionuclides that occur both naturally and artificially are tritium, carbon-14 and potassium-40. Waste solids containing artificially enhanced concentrations of such radionuclides are controlled under RSA 93 but with the natural levels discounted. They are then treated in the same way as materials/wastes containing other artificial radionuclides.

The Substances of Low Activity Exemption Order

Relationship to Schedule 1 radioelements

The Substances of Low Activity Exemption Order (SoLA) was made under RSA 60 in 1986. Amongst other things it exempts persons unconditionally from registration under Section 1 of RSA 60 and excludes from Section 6 of RSA 60 the disposal of radioactive wastes as long as those wastes are **substantially insoluble** and contain only low levels of radioactivity. This Exemption Order applies to the natural radioelements set down in Schedule 3 of RSA60. It effectively allows up to 0.4 Bq/g to be added to the Schedule 3 values before substantially insoluble material has to be treated as radioactive. This increase is significant for example for radium (0.4 + 0.37 Bq/g) but only minor for uranium (0.4 + 11.1 Bq/g). The 0.4 Bq/g figure may have come from the fact that global average levels of uranium-238 and thorium-232 in soils are each about 0.025Bq/g, and allowing for the 8 uranium series and the 6 thorium series alpha emitting daughters present in equilibrium would give about 0.35 Bq/g.

Other radionuclides.

The clearance levels in SoLA, for other than Schedule 1 radioelements, are in terms of radionuclide concentrations above any natural background levels. The BSS Directive radiological criteria for clearance are also in terms of doses that

are additional to natural background radiation. To apply these clearance levels for radionuclides that occur naturally and artificially it is necessary to define their normal natural background concentrations in solid materials, subtract these from the measured total concentrations, and compare the remaining concentrations to the clearance levels. This cannot be done in a generic way because of the variation in natural background concentrations from place to place.

In general, users of SoLA need to determine the concentrations of the relevant radionuclides (for example, carbon-14) arising from nature and agree these natural background concentrations with the staff of their relevant Environment Agency Office, before applying them in determining compliance with SoLA. Some independent monitoring of natural background concentrations in the locality is likely to be required by the Environment Agency. A simpler approach is possible when natural background concentrations of the relevant radionuclides are much lower than the clearance levels; in such cases the SoLA level can be effectively applied to the total measured concentrations of the relevant radionuclides in solid materials.

Examination of clearance prior to the implementation of the Revised Basis Safety Standards Directive

Within the current UK framework the SoLA (and Schedule 1) values could also be viewed as unconditional clearance levels. Such clearance levels allow the unrestricted disposal, re-use or recycling of any volume of insoluble (and solid) materials, with no further control once the material leaves the originating facility or practice being regulated. The Directive set down, amongst many other things, clearance criteria; and in 1998 a DETR report (DETR/RAS/98.004) was produced which derived clearance levels for metals, concrete, soils and general wastes, partly to check whether SoLA and Schedule 1 conformed to these criteria. The calculations showed that artificial radionuclides could be placed in three groups for the purposes of setting clearance levels, see Table 5 below.

Table 5 Groupings of clearance levels-not adopted

Group	Clearance level(Bq/g)	Group description and examples of radionuclides in the group
I	0.1	Strong gamma emitters, e.g. iron-59, cobalt-60, caesium-134, caesium-137
II	1	Alpha emitters, most beta emitters, other gamma emitters, e.g. plutonium-239, americium-241, ruthenium-106,
III	10	Low energy emitters, e.g. tritium, carbon-14, nickel-63

After consultation on these levels it was decided to remain with the status quo.

Recent European and International Guidance

European Commission guidance on general clearance levels for solid radioactive materials is in the form of recommendations made by the group of experts established under the terms of Article 31 of the Euratom Treaty. It is given in the report Radiation Protection 122, parts 1 and 2, which was published in 2000.

The International Atomic Energy Agency (IAEA) has produced International Basic Safety Standards, see Safety Series 115-1, 1994, which sets down exempt activity concentrations akin to clearance values. The IAEA has also produced scope-defining levels for radionuclides in commodities in their document DS 161, these are also akin to clearance values.

DEFRA keeps under review the criteria, methodologies and clearance levels proposed by European and International bodies. It is becoming increasingly difficult making the existing UK legislation fit into an International and European regulatory regime based on “practices” and “work activities”.

7 Other important Exemption Orders.

The Radioactive Substances (Phosphatic Substances, Rare Earths etc.)

Exemption Order 1962 to give it its correct name, was created mainly to prevent everyday articles/substances such as phosphate containing fertilisers, thoria

ware, refractories, and some glasses and ores having to be labelled “radioactive”. The main restrictions in the EO about radioactive waste are that waste must only be considered as radioactive waste because of the presence of Schedule 3 (RSA 60) radioelements and that the waste must be substantially insoluble in water. The activity concentration limits in the EO i.e. 14.8 and 37 Bq/g, refer to the total sum for all radionuclides for each radioelement. The Environment Agency has provided guidance on the computation suggested for demonstrating compliance.

Other EOs made in 1962 that are relevant to Schedule 1 are those for Lead, Uranium and Thorium, Prepared Uranium and Thorium Compounds.

Revision of the EOs has been and is continuing to be kept under consideration; for the latest Defra publication on work relating to proposed revision, see Mike Thorne et al, DEFRA/RAS/02.013 .

8. A guide to the administration of the Act

An HMSO document entitled Radioactive Substances Act 1960, A guide to the administration of the Act, which was published in 1982, is silent on the meaning behind Schedule 1.

The guide describes a number of disposal routes. It introduces the term VLLW for the first time. It describes this as solid (<0.4 Bq/g) and organic solvent wastes containing only tritium and carbon-14 as being wastes of the VLLW category. It indicates that a subsequent Low Activity Substances Exemption Order would be created to formalise this disposal option. SoLA was the eventual EO created to meet the recommendation of an Expert group regarding the disposal of very low concentrations of radioactivity and also to implement Article 4 of the 1980 Euratom Basic Safety Standards Directive 80/836.

Under the heading “Low Level Waste (LLW) in domestic refuse” the limits of such “dustbin disposal” are set out with reference to volumes of 0.1 m³ and discrete articles containing tritium and carbon-14, although mention is made of usually excluding alpha and strontium-90 emitters. Over time this has become what is today called VLLW in the Environment Agency Authorisations for non-nuclear sites, which allow eg. incinerator ash and spent lime to be disposed of to controlled landfill sites. Dustbins are no longer common receptacles and VLLW from incinerators are often moved in lorries in 20 ton plus loads.

Authorisations for “Special precautions disposals” are also described in terms of activity within a sack. The usual limits being 4MBq of radionuclides of half life greater than 1 year, except where the radionuclides are only tritium or carbon-14 when the limit is 200 MBq per sack

A further heading is for “Demolition wastes and other high volume wastes which are of low specific activity or are lightly contaminated.” For those with levels less than 4Bq/g removal to a tip and burial with a cover of at least 1.5m is allowed. Waste up to 1Bq/g is said to be acceptable to leave on site if significant economic savings can be made. Burial of wastes with > 1Bq/g is said to only be authorised in special circumstances.

9 Use of landfill sites.

Some examples of the use of landfill sites are provided below

BNFL’s Sellafield site has several landfill areas within it. Disposal up to 37Bq/g are allowed for in the authorisations. Conditions are applied.

BNFL’s Springfields and Capenhurst sites have send wastes for many years to the Clifton Marsh refuse pits and Ulnes Walton disused clay pits sites. At Clifton Marsh authorised limits are 11,000 te/ year and 0.03 TBq of uranium activity; these limits equate to an average of 3Bq/g.

Amersham plc and Devonport Royal Dockyard Ltd are also authorised to send some VLLW for landfill disposal.

The EA Radioactivity in the Environment Annual Reports gives some details of discharges from 7 landfill sites.

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Table 6 Development of UK regulation relating to radioactive substances control

Date	Event
1948	Radioactive Substances Act
1956	Expert Panel set up to advise on control of r/a waste
1959	Cmnd 884 Report of Expert Panel appended
1960	Radioactive Substances Act for England, Wales, Scotland ,Northern Ireland and Continental Shelf
1962	Exemption Orders; Phosphatic Substances, Lead, U & Th, Prepared U & Th compounds
1963	RSA60 comes into force with Explanatory Memorandum
1982	A Guide to the Administration of the Act, December 3, date for implementing BSS

NOT APPROVED DEFRA POLICY GUIDANCE

1986	SoLA Exemption Order
1992	SoLA Exemption Order, amended
1993	Radioactive Substances Act 93
1998	DETR/RAS/98.004 Clearance levels
1999	DETR/RAS/99.015 EO compliance with Revised BSS
2000	DETR/RAS/00.003 Guidance on Schedule 1 Radioactive Substances(Basic Safety Standards)(England & Wales) Direction 2000
2002	DEFRA/RAS/02.013 Revision of Exemption Orders.

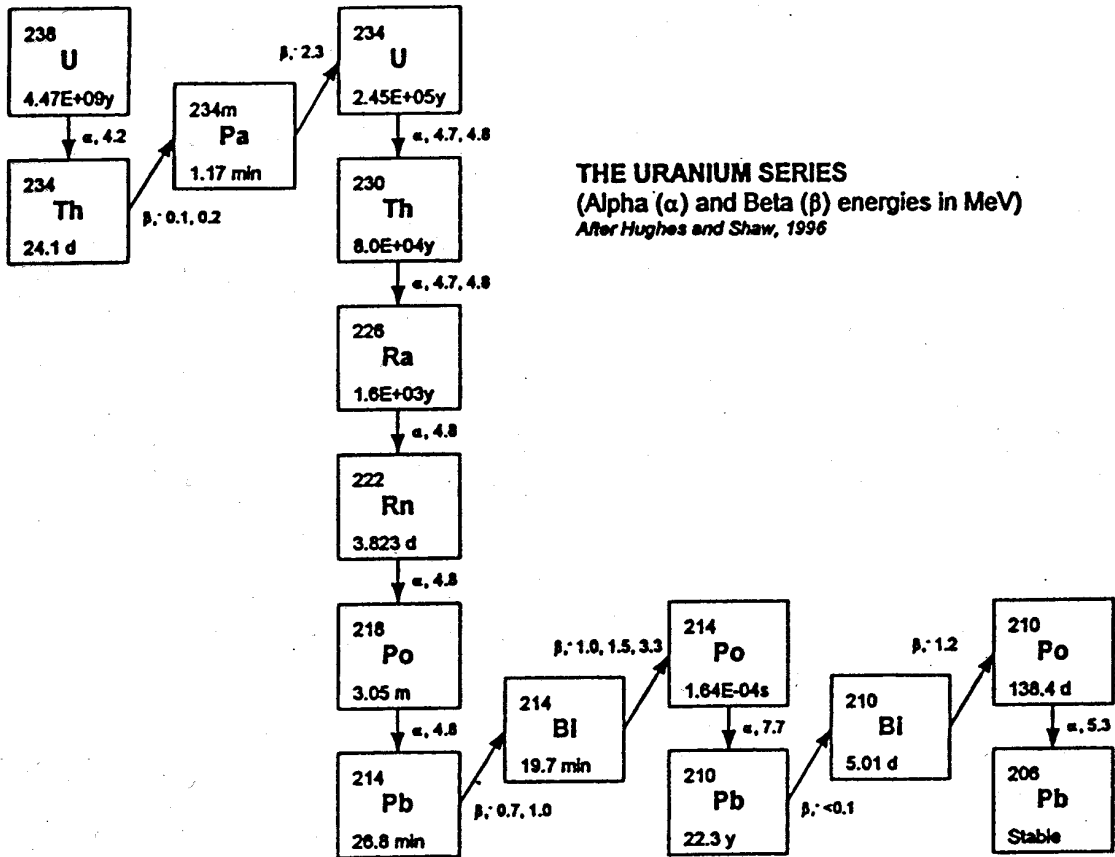


Figure 1

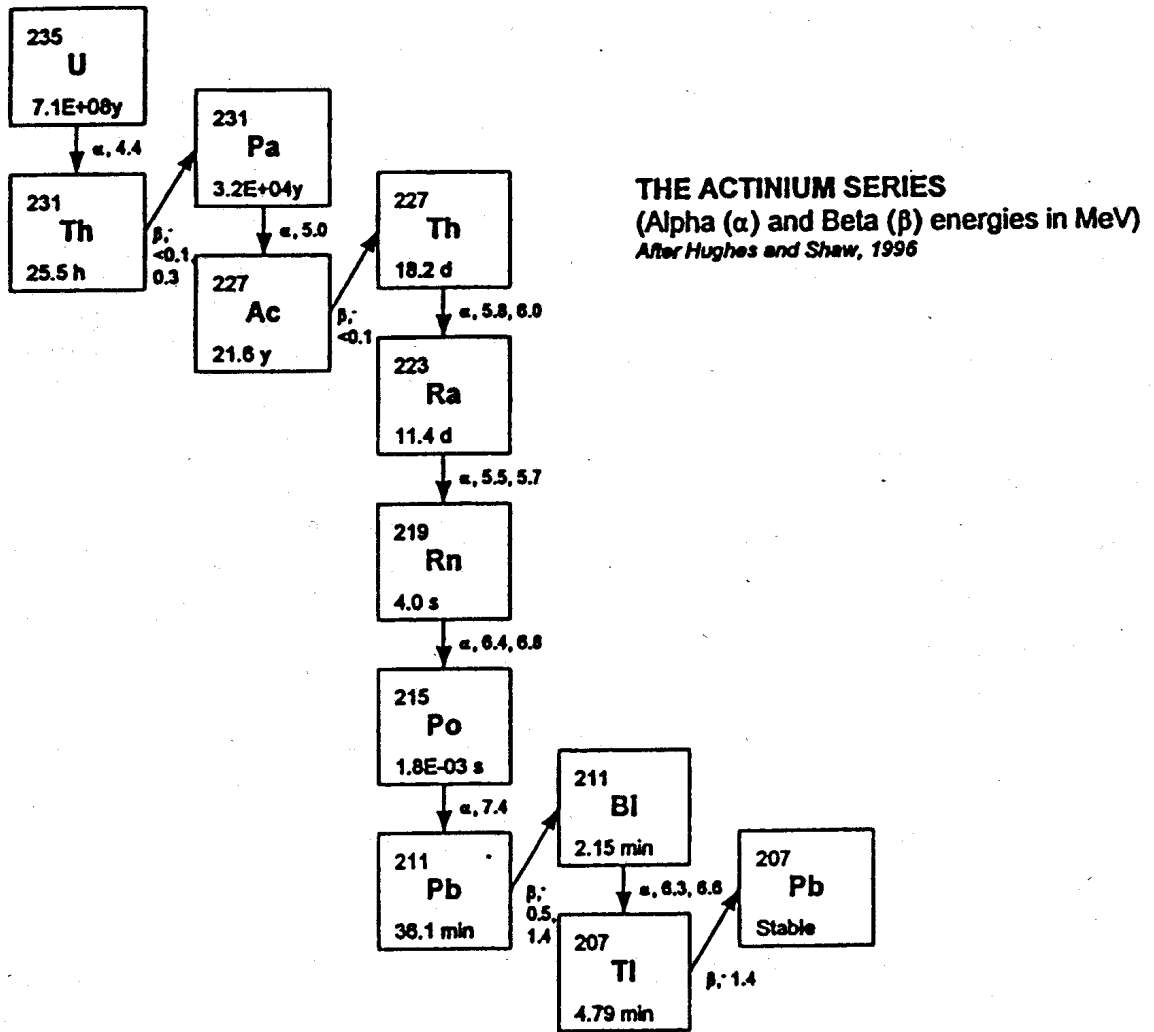


Figure 2

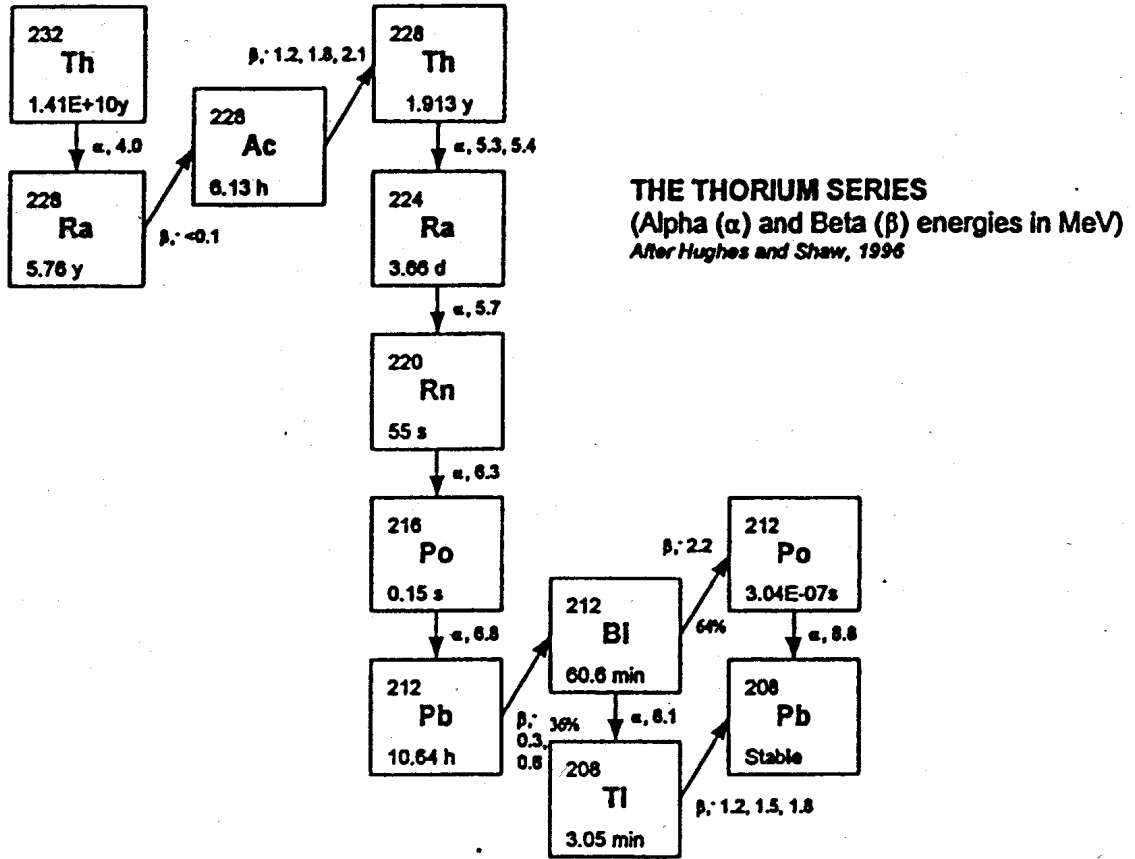


Figure 3