



HM Nuclear Installations Inspectorate

A review by HM Nuclear Installations Inspectorate

**Urenco (Capenhurst) Ltd's strategy  
for decommissioning its  
nuclear licensed site**

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## **FOREWORD**

This report sets out the findings of a review by the Health and Safety Executive's Nuclear Installation Inspectorate, in consultation with the Environment Agency, of the Urenco (Capenhurst) Ltd\* decommissioning and waste management strategies for its nuclear licensed site.

The review was undertaken in accordance with the 1995 White Paper "Review of Radioactive Waste Management Policy: Final Conclusions", Cm 2919, which stated that the Government would ask all nuclear operators to draw up strategies for the decommissioning of their redundant plant and that the Health and Safety Executive (HSE) would review these strategies on a quinquennial basis in consultation with the environment agencies.

The review compares UCL's strategy with national and international guidance, considers the underlying assumptions made and whether the plans are comprehensive and appropriate. The Company's internal mechanisms to quantify the tasks are reviewed. NII intends to formally review UCL's decommissioning strategy again in five years time to ensure that progress is being made and that it remains appropriate should new information change current assumptions.

UCL's strategy document is attached as an Annex to this report.

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\* Throughout this report Urenco (Capenhurst) Ltd is abbreviated to UCL.

## **EXECUTIVE SUMMARY**

The 1995 White Paper “Review of Radioactive Waste Management Policy: Final Conclusions”, Cm 2919, determined that the Government would ask all nuclear operators to draw up strategies for the decommissioning of their redundant plant and that the Health and Safety Executive (HSE) would review these strategies on a quinquennial basis in consultation with the environment agencies.

This review has considered UCL's arrangements for the identification of its responsibilities for decommissioning and radioactive waste management, the quantification of the work entailed and the standards and timing of the work.

This is the first review by the HSE in response to Cm 2919 of UCL's decommissioning and radioactive waste management strategies. It reports the Nuclear Installations Inspectorate's (NII) view that the strategies proposed by UCL are generally appropriate. The strategies are considered to be largely consistent with both national and international policy statements and guidance.

During the review the NII has considered whether UCL has identified all the tasks required to fully decommission its site. Generally this has been found to be the case.

One of the purposes of this review process is to challenge the operator's decommissioning strategy assumptions every five years. Future reviews will progressively clarify the assumptions used. The current report primarily reports on NII's assessment of the licensee's 2002 decommissioning strategy statement. However, this has been modified as a result of regulatory exchanges during 2003 and in this report we have taken account of recent refinements made by UCL.

The current UCL strategy assumes that the end point of decommissioning will be the return of the site for commercial non-nuclear activities. This is different to current industry practice in the UK which assumes that the end point of decommissioning will be delicensing, subject to an interpretation of the 'no danger' clause in Section 6 of the Nuclear Installations Act 1965 (as amended). The HSE is currently reviewing its policy on the use of this clause and is working towards transparent and practical guidelines. Ultimately, the cost of delicensing must be borne by UCL or a successor licensee and HSE sees advantages in making appropriate provision for these activities should delicensing be more difficult than currently assumed by UCL.

During this review, the NII raised concerns over the adequacy of the models for assessing overhead costs after income generating activities had stopped since it needs to set aside by 2035 (the date when proposed revenue earning enrichment operation cease) all the funding required to underwrite decommissioning, tails management, waste management and eventual disposal through a period up to 2153. The current decommissioning and tails liability estimate is £54M which is subject to annual review.

The majority of the funding is to be provided from revenue earned from enrichment operations. Currently there is no segregated fund in place to meet these decommissioning costs which in NII's view may be contrary to Government policy in Cmnd 2919. However, NII recognise that significant tails management spend is likely to be incurred and funded from earned revenue before 2035. Arrangements are in place within UCL to regularly review, and where appropriate amend, the level of this funding. These arrangements will be subject to appropriate regulatory oversight.

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## INTRODUCTION

1. The White Paper on radioactive waste management policy (Cm 2919, reference 1 paragraph 124) stated: *“The Government believes that, in general, the process of decommissioning nuclear plants should be undertaken as soon as it is reasonably practicable to do so, taking account of all relevant factors. In future it will ask all nuclear operators to draw up strategies for decommissioning their redundant plant. These will need to include justification of the timetables proposed and demonstration of the adequacy of the financial provision being made to implement the strategies”.*
2. In order to ensure that operators’ decommissioning strategies remain soundly based as circumstances change, the White Paper placed a requirement (reference 1 paragraphs 126 and 183) that these strategies be reviewed quinquennially by the Health and Safety Executive (HSE), in consultation with the environment agencies [the Environment Agency (EA), and in Scotland the Scottish Environment Protection Agency (SEPA)]. The HSE requested HM Nuclear Installations Inspectorate (NII) to undertake the reviews on its behalf. The NII is one of the specialist inspectorates of the HSE.
3. The White Paper recorded the importance of ensuring that appropriate financial arrangements are in place to cover the costs of decommissioning nuclear facilities. It was concluded that segregated funds should be established for those parts of the industry which are privatised and that the Government would examine what improvements could be made in the way in which the state-owned sections of the industry report on their progress towards decommissioning and on their provisioning policies. It was decided (reference 1 paragraphs 131 and 184) that the quinquennial review should provide the right focus for improved reporting of this kind.
4. Currently, there are 40 nuclear licensed sites (‘sites’) in the UK operated by a total of 15 licensees. The funding of liability provisioning is a corporate matter and it is possible that expensive tasks will be required to be undertaken simultaneously on separate sites. In its statement (reference 1 paragraph 127) that: *“Proposals for dealing with ...(other nuclear facilities) will need to be included in the operator’s decommissioning strategies”*, the White Paper implied that the quinquennial review should be comprehensive. For these reasons, the HSE is reviewing decommissioning strategies licensee by licensee, not site by site. In the case of Urenco Group, there are three operational sites, one each in Germany, Holland and the UK. HSE's review is confined to the Capenhurst site but has taken account of Urenco Group policies and strategies where appropriate.
5. A report of the Inquiry into a planning application made by Magnox Electric plc for the Trawsfynydd Nuclear Power Station was published on 19 March 2003 (reference 2). This report comments on the QQR process and notes that:

“It appears to be accepted that the QQR is a powerful mechanism to secure continuing improvement and early decommissioning from the licensee.”

6. The present report reviews the UCL decommissioning strategy for its site at Capenhurst as described in the document UCL Decommissioning Strategy Summary Paper Prepared in Support of the 2001 Quinquennial Review; Issue 1, March 2002 (Reference 3). This is reproduced at the end of this report for ease of reference and for consistency with other NII Quinquennial reports. The report also takes account of a number of more recent improvements made by UCL as a result of regulatory discussions during 2003. It also looks at UCL's financial liabilities at Capenhurst and the interactions with other stakeholders, particularly British Nuclear Fuels Ltd (BNFL). It is noted that UCL has interactions with other parts of the Urenco Group but these aspects have not been explored as part of this review. (The history of the Capenhurst site is discussed later in this report).
7. Licensees' plans for decommissioning are subject to revision as knowledge and circumstances develop. The quinquennial review process gives the opportunity to consider the adequacy of the plans at particular points in time, once every five years. In general, the present report describes the review of UCL strategy as established in March 2002.
8. The Government has announced new arrangements to oversee decommissioning of much of the UK's nuclear waste legacy by the formation of a Nuclear Decommissioning Authority (NDA). The Urenco site at Capenhurst is not included in the remit of NDA's decommissioning activities.

## **BACKGROUND TO THE REVIEW**

### ***The work required of the HSE***

9. The White Paper identified two specific aspects of decommissioning for independent review to ensure that the work will be carried out. These are a "strategy" (i.e. overall approach and programme) for the work and "provisioning" (i.e. the funds to be available, when required, to undertake the task safely). The HSE was specifically given the task of reviewing, in consultation with the environment agencies, the decommissioning strategies of each nuclear operator. This is required to be carried out on a five-year cycle and, by inference, to include the arrangements for financial provisioning. HSE will consult other Government Departments including the Environment Agencies, DTI, DfT as appropriate. Detailed consideration of financial aspects is outside the scope of the present report.

### ***The legislative background***

10. The main legislation governing the safety of nuclear installations in the UK is the Health and Safety at Work etc, Act 1974 (HSW74) (reference 4) and the associated relevant statutory provisions of the Nuclear Installations Act 1965 (as amended) (reference 5). Under the Nuclear Installations Act (NIA65) no site may be used for the purpose of installing or operating a nuclear installation unless a nuclear site licence ('licence') has been granted by the HSE (reference 6). The NII is that part of the HSE with delegated responsibility for administering this licensing function and enforcing NIA65 and HSW74 on nuclear sites.

11. NIA65 provides the NII with powers to attach conditions to the licence in respect of safety and in respect of the management of nuclear matter, which includes radioactive waste. HSW74 provides the regulatory powers to enforce these conditions. There are currently 36 licence conditions attached to the nuclear site licence.
12. Licence Condition 35 requires that adequate arrangements are made and implemented for the decommissioning of any plant or process that may affect safety and that adequate arrangements are made for the production and implementation of decommissioning programmes for each plant. Furthermore, the licensee is required to provide adequate documentation to justify the safety of proposed decommissioning activities and, where appropriate, provide this documentation to the HSE. By these provisions, the NII has the power to require each licensee to supply it with the details and programmes of its decommissioning proposals. This information is supplied to the HSE under the terms of HSW74 and hence has certain restrictions on disclosure.
13. The routine regulation of licensees' decommissioning work by the NII relates generally to individual plants and facilities. This decommissioning is overlain by the licensee's site-wide programme that prioritises the work and ensures the maintenance of facilities upon which other plants will depend for their decommissioning. The licensee's operating arrangements are regulated by the NII and where appropriate incorporate good practice. They are designed to satisfy the obligations placed on licensees by the conditions attached to the licence and include:
  - in the design of new facilities, taking account of the work that will be required to clean and dismantle the facility at the end of its life;
  - during the active commissioning, operational and decommissioning phases of the plant, minimising the generation of radioactive waste and contamination of plant;
  - decommissioning plans to be developed in the safety case for each operational plant, and reviewing these plans regularly with the NII;
  - prior to the end of the operational phase of the plant, preparing detailed decontamination and decommissioning plans; and
  - undertaking decommissioning work only in accordance with an adequate safety case.
14. In reviewing the decommissioning proposals presented by a licensee, the NII would expect some gradation in the detail of proposals for specific plant. A plant not yet in operation is likely to have only outline plans for decommissioning although the eventual need to decommission should be taken into account at the design stage. During operation of the plant the level of detail contained in the plans will be progressively increased until, nearing the end of operation, the plant will have a fully detailed decommissioning

proposal. The progression described above could be represented by documentation prepared by a licensee as follows:

- decommissioning proposals as part of the pre-operational safety case;
- production of a pre-decommissioning plan (regularly updated);
- presentation of a safety justification for the option chosen in the decommissioning plans;
- establishment of a pre-decommissioning safety case;
- development of an environmental study for the chosen option;
- consultation of an environmental impact statement; and
- submission of a fully developed decommissioning safety case.

15. NII has four fundamental expectations for decommissioning, which should be met so far as is reasonably practicable. These expectations, which are consistent with current Government policy, are as follows:

- in general, decommissioning should be carried out as soon as is reasonably practicable, taking account of all relevant factors;
- hazards associated with the plant or site should be reduced in a progressive and systematic manner;
- full use should be made of existing routes for the disposal of radioactive waste; and
- the remaining radioactive material and radioactive waste should be put into a passively safe state for interim storage pending future disposal or other long term solution.

16. This approach accords with NSD's published guidance 'Nuclear Safety Directorate, Guidance for Inspectors: Decommissioning on Nuclear Licensed Sites which is available on the internet.

17. The authorisation of discharges and disposal of radioactive waste arising from operations and decommissioning is regulated by the Environment Agencies under the terms of the Radioactive Substances Act 1993 (RSA93). (reference 7). The management of nuclear matter, including radioactive waste, on nuclear licensed sites is regulated by the NII. Formal administrative arrangements ensure that the NII and the Environment Agencies work closely together to ensure compliance with requirements.

18. The NII regulates the work of decommissioning in the same manner as all other work undertaken on the site. This includes the assessment of licensees' proposals for work, and the inspection of work as it proceeds. Arrangements are in place to ensure, where appropriate, that the work is planned in phases with hold points. By this means, the NII regulates decommissioning work. The experience that the NII has gained from this regulation over many years has been used in this review. UCL's strategies relating to conditioning and the storage of material that might have future disposal issues or involving NIREX acceptance will need agreement from the Environment Agency's National Waste Assessment Team (NWAT).
19. In addition to these regulatory activities, and as part of the quinquennial review, the NII has examined UCL's activities in two other areas:
  - first, to consider the adequacy of the long term plans for the eventual removal of all nuclear plant and facilities from the Urenco Capenhurst site;
  - second, to consider the provisioning strategy for UCL's decommissioning and waste management liabilities so that work may proceed unimpeded.
20. NIA65 places significant obligations and responsibilities on the licensee. Under current legislation the period of responsibility (reference 5 Sections 3(6) and 5(3)) does not end until the HSE is able to declare that there is no danger from ionising radiation from anything on the licensed site. It is generally assumed that a licensee will wish to be relieved of these responsibilities and will plan the decommissioning of individual sites to achieve this.
21. The White Paper Cm 2919 reported that the Government was intending to introduce legislation in respect of radioactive contaminated land. This has yet to be finalised. In the absence of other guidance, the NII expects the licensees to manage the decommissioning of their sites to achieve a systematic and progressive reduction in the hazard presented (reference 1 paragraph 125), towards a situation where no danger from ionising radiation remains on the site and the licensee's period of responsibility under NIA65 could be terminated. That is the basis of the present review.

## **THE REVIEW OF URENCO (CAPENHURST) LTD**

### ***Background***

22. Urenco (Capenhurst) Ltd (UCL) is the UK subsidiary of Urenco Enrichment Company, (UEC) which is a subsidiary of Urenco Ltd, a British-German-Dutch organisation which operates uranium enrichment plants using gas centrifuge technology. Urenco supplies a uranium enrichment service to nuclear power station operators world-wide. The Head Office of Urenco Ltd and UEC are at Marlow, Buckinghamshire, where marketing and sales staff are located. The organisation has three enrichment sites - at Gronau in Germany, at Almelo in the Netherlands and at Capenhurst, near Chester, in the UK.

23. UCL is a nuclear licensed site, which was formed in March 1993 after a transfer of undertakings from part of BNFL. UCL's primary business activity is the operation of centrifuge enrichment plants. From October 2003, the design and engineering expertise for the Urenco Group is provided by Enrichment Technology (UK) Ltd a separate wholly owned subsidiary of Enrichment Technology Company ETC which is part of Urenco Group. ETC also provides similar services to customers outside the Urenco Group. UCL employs ~350 personnel. There is also a facilities management contractor with ~35 employees on site.
24. BNFL remains the licence of the original Capenhurst site. The two companies (BNFL and UCL) thus have two sites which abut one another. They are independent but they co-operate through inter-company service agreements, to provide each other with a number of services (e.g. UCL health physics services to BNFL and BNFL waste disposal services to UCL) and also come together to implement the joint emergency procedures for the combined Capenhurst site. UCL's dependence on BNFL is expected to diminish as operational activities on the BNFL site reduce. In terms of turnover, size and activities, UCL is now the larger of the two licensees at Capenhurst.
25. UCL currently operates three centrifuge plants (E22, A3 and E23) and a small number of other facilities in support of the centrifuge plants (e.g. maintenance workshops and analytical laboratories).
26. The present enrichment capacity is ~2930 tonnes separative work. Additional enrichment capacity is currently being installed in the E23 Plant. Assuming that this is completed as planned, the enrichment capacity will rise to ~3500 tSW in 2007.
27. Since its formation in 1993, UCL has successfully completed the decommissioning of two facilities namely the K Bay technology demonstration centrifuge pilot plant and the E21 commercial demonstration centrifuge enrichment plant. Both of these projects have been completed to time and cost. In addition, the decommissioning of the redundant plant and equipment from the historic Research and Development Facility has also been completed in 2002.
28. The depleted Uranium Hexafluoride, known as tails, which arises as a by-product from the enrichment process is taken off in internationally approved 48 inch type cylinders and transferred to on-site storage rafts. Currently there are three such rafts, rafts 6, 7 and 8, which together have a storage area of 10,464 sq.m. At a working site (i.e. readily accessible) packing density these rafts can accommodate approximately 2000 cylinders. Further storage rafts (11 + 12) have also recently been completed on the site of the previous E21 Centrifuge Enrichment Plant which provides further space for approximately 2000 cylinders.
29. In addition to the storage of tails in type 48 cylinders, UCL stored a small quantity of tails in type 0236 containers from historic operations. At the end of 2002, UCL's tails inventory amounted to ~5700 te U stored in ~630 type

48 cylinders and 435 type 0236 cylinders. The ownership of 0236 cylinders has been now transferred to BNFL and the cylinders moved off the UCL site.

30. UCL has an ongoing contract, up for renewal in 2007, with Technabexport of Russia, which takes ex UCL tails cylinders and re-enriches the material to low enrichment product and/or pseudo natural. The product is sold on and the pseudo natural is re-fed or sold on. The operation of this contract is maintaining a steady state of net tails stocks on Capenhurst site.

### ***UCL Radioactive Waste Management Strategy***

31. Regarding Low Level Waste (LLW) the UCL strategies for management of radioactive waste do not make presumptions on the availability of BNFL Drigg as a disposal route. The current expected date by which the Drigg waste disposal facility will be exhausted is not later than about 2050, so only those wastes which arise from the early decommissioning stages will depend on Drigg and the volumes/inventories associated with these wastes are not significant. There may be some future concern regarding the availability of a facility to dispose of LLW once Drigg is closed, however this is a national issue rather than one specific to the decommissioning of UCL site. We are aware that UCL currently depends on other operators, particularly BNFL, for treatment and disposal of radioactive waste and current routes may no longer be available in the medium term post 2006/2007. It is also noted that UCL hold limited stocks (less than 1te) of magnesium fluoride for which no disposal route is currently available and for which there should be a limited programme of research and development.

**Finding No. 1:**                      Availability of Disposal Routes - UCL to review the dependency upon BNFL disposal routes which may no longer be available after 2006/07.

**Finding No. 2:**                      ILW Waste Streams - UCL should review the adequacy of existing strategies for conditioning of waste streams and provide evidence of suitable programmes of research and development where appropriate.

32. NII believes that there are advantages for UCL in pursuing a strategy for the deconversion of tails hex to oxide since this form is more stable and more likely to meet final disposal requirements in parallel to the current strategy of tails re-enrichment.
33. The NII regards the strategies proposed by UCL for decommissioning its enrichment production facilities and for radioactive waste management to be appropriate. They are largely consistent with both national and international policy statements and guidance and are potentially flexible enough to be able to accommodate lessons learned during ongoing decommissioning activities. NII notes that any new build of a decontamination facility will require a BPEO /

BPM study and may also require a variation of existing discharge authorisations.

34. As a result of NII's assessment we have concluded that UCL has a well developed and comprehensive set of site specific strategies for the management of redundant facilities and tails hex. NII would expect on-going radioactive waste management issues to be addressed as part of on-going regulatory requirements under nuclear licence conditions.

### ***Contaminated Land***

35. A liability which may exist on the UCL site for which the strategy is not fully developed is contaminated land. Radioactive material and radioactive waste on a nuclear licensed site must be adequately controlled or contained in accordance with the requirements of the site licence (reference 6). In the event that it is not adequately contained, contamination of the land may occur by:

- spillage either directly or indirectly onto the surface of the ground;
- leakage into the ground due to loss of containment from storage facilities or buildings, or failure of engineered services; or
- burial either unauthorised or authorised in accordance with the appropriate Radioactive Substances Act (RSA 93) and satisfying the BPEO principle (Best Practical Environmental Option).

36. UCL has embarked on a long term programme of work to establish the extent and radioactive inventory of contaminated land on its site. The NII is generally satisfied with the work being carried out by UCL to establish adequate knowledge of contaminated ground on its site based on a historical knowledge of land use. Further work will provide increased confidence that land has been adequately characterised by UCL and the NII expects to see continued development in this area as part of programmed work. It was noted that work has been completed on the UCL site to carry out general land surveys.

**Finding No. 3:**                      Land characterisation - UCL needs to complete its extended land characterisation studies and develop a Contaminated Land Policy.

37. UCL's position with respect to radioactively contaminated land is that a significant proportion of the site was undeveloped before the construction of its enrichment plants and that those areas are unlikely to have been contaminated prior to UCL's occupation. UCL is confident that its own operations will not have caused any contamination subsequently.
38. Some of the areas taken over from BNFL are covered by a lease which relieve UCL of the liability for the remediation of any radioactive contamination of the land which was not a consequence of UCL's occupation.

39. Against this background, and following a desk-top review, UCL does not provide for the remediation of radioactively contaminated land. However UCL recognises that a robust and definitive position cannot be established without an adequate survey which now forms part of UCL's future strategy in this area. [Note Finding No 3 – Land Characterisation].

### ***Delicensing***

40. It is a key strategy assumption of UCL that the end point for site decommissioning is reversion of the site back to non-nuclear commercial activities. There is no clear commitment to delicense the site either for greenfield, brown field or non nuclear industrial activities. This is in contrast to the normal industry assumption that the end-state should be delicensing (which is understood to be when the site licence could be revoked by the HSE and UCL's period of responsibility under NIA65 could be terminated).
41. The HSE is currently reviewing its policy on the use of the 'no danger' clause of the NIA65 and is working towards transparent and practical guidelines. However, until such a time as this work is completed, it will remain difficult to predict with certainty the degree to which sites could be 'delicensed'. Until a site is 'delicensed' the NII will require any radioactivity in the ground to be managed as accumulated nuclear material, in accordance with the nuclear site licence.
42. UCL's strategy for progressively clearing up redundant areas of site has been based on a presumption that some of those areas were not used for the processing and treatment of radioactive materials. So, in accordance with its current civil engineering practices, UCL has only removed some building surface structures. The NII considers that this may make it more difficult for UCL to demonstrate 'no danger' under the current policy. The NII/ EA preferred strategy is for the site to return to greenfield status which require a Best Practicable Environmental Option (BPEO) study from UCL to justify any end state assumption.
43. In the NII's view, these factors have the potential to lead UCL to underestimate the site management and decommissioning liability. It is therefore recommended that, before the next HSE quinquennial review, UCL undertakes further work to assess whether an inability to delicense would increase or decrease its provisions requirements.

**Finding No. 4:** Delicensing – UCL should undertake further work as appropriate to determine the sensitivity of provisioning requirements to the assumption on delicensing.

### ***Records Management***

44. The continued absence of a UK disposal route for ILW and LLW in the longer term i.e. beyond the currently anticipated life of Drigg, places an increased emphasis on the need for the nuclear industry to maintain adequate records of radioactive materials and the facilities within which they are stored. Whilst

the present generation requires that these materials are managed safely, future generations are entitled to expect that they inherit adequate and sufficient information, not only to allow the eventual disposal of the material but also to support safe economic management until that time.

45. UCL accepts that safe management for the long term of both unconditioned and conditioned stored radioactive wastes requires the maintenance of adequate records. In confirmation of this, UCL has continued its involvement in the British Radwaste Information Management Systems (BRIMS), the development of which was co-ordinated in the UK by the nuclear industry, regulators and government departments in seeking to address record keeping for the long term management of radioactive waste.
46. The provision of records to aid decommissioning for the future is an important issue. UCL corporate arrangements have recently been established which should ensure the availability of the many reports including those from earlier BNFL operations and other references for the future. In view of recent organisational changes at Capenhurst, NII sees advantages for UCL in reviewing and strengthening its arrangements for records management in respect of radioactive waste management. Progress in this area will be monitored at the next quinquennial review of UCL by the HSE.

**Finding No. 5:**                      Records Management - UCL needs to review and strengthen arrangements for the long term retention of records required for radioactive waste management.

### ***UCL organisational arrangements***

47. With the transfer of assets to UCL from BNFL ownership in 1993 the arrangements for decommissioning and liability management have been subject to a number of reorganisations. This changing environment, unless carefully managed, increases the potential for corporate memory loss and general loss of expertise. However, recognising the recent company restructuring, the arrangements for retaining decommissioning experience will need to be kept under review since UCL, the licensee and plant operator, will need to ensure a retained intelligent customer capability to use the services of Enrichment Technology (UK) Ltd. The UCL arrangements for collection of information on decommissioning seem to be currently acceptable.
48. NII also notes that the decommissioning strategy (and the assessment by NII) is site based at Capenhurst to reflect the organisation of the nuclear licensee, Urenco (Capenhurst) Ltd. Other Quinquennial Reviews undertaken by NII have been focussed at a company level and often encompass more than one site. We are aware that the licensee UCL can call upon Urenco Group resources from sister sites in Holland and Germany but it is considered that examination by NII of such aspects is outside the scope of the current review, although the Urenco Group headquarters are in Marlow, UK.

### **Comparison with other “good practice”**

49. UCL benefits from close working arrangements with BNFL which has a much wider portfolio of decommissioning projects. Urenco Group also operates enrichment plants in other parts of Europe and can therefore identify good practice from other parts of the EU. We are aware that UCL participates when appropriate in the activities of international groups such as IAEA/OECD-NEA and is therefore well placed to take advantage of good practice elsewhere (references 8, 9, 10, 11, 12, 13, 14).

### **III Assessment of Radioactive Waste Management and Decommissioning Aspects**

50. Urenco’s decommissioning strategy is set out in Annex 3. It represents a snapshot of the situation as it existed when the document was finalised in March 2002. A number of assumptions underpinned the strategy as submitted by UCL. The key assumptions relating to the decommissioning of plant and buildings are:

- the strategy covers enrichment plants A3, E22 and E23 A to E23 E<sup>1</sup>;
- decommissioning of contaminated plant is to be undertaken as soon as is reasonably practicable after the cessation of operations, subject to the availability of the required resources;
- provision for decommissioning is built up over the lifetime of the plant, which for accounting purposes is deemed to be 12 years from the on-line date of the plant;
- the UCL decommissioning strategy relates to the liability to remove, decontaminate and dispose of all Uranic contaminated plant and material such that the ex-plant buildings are left clean and available for general use;
- no further large scale enrichment plant decommissioning will be undertaken at Capenhurst before 2012.
- a 30 year lifetime for the enrichment plants, with the cessation of all productive operations by 2035;
- the start to finish time of a project to decommission a commercial size centrifuge plant is of the order of 5 years.

There is no commitment to delicense the site when the decommissioning etc. has been completed; UCL’s decommissioning policy is that: *“It is not Urenco’s policy to return the facility to a greenfield site”*. There is also an

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<sup>1</sup> Enrichment plant E23E is still under construction. Construction of a further new plant - E23G - is being undertaken in 2004.

assumption that an alternative commercial use will be found for the site by UCL when productive nuclear activities cease, and that this alternative use will then carry the site overheads.

51. The NII regards the strategies proposed by UCL for decommissioning its enrichment production facilities and for radioactive waste management to be appropriate. They are largely consistent with both national and international policy statements and guidance and are potentially flexible enough to be able to accommodate lessons learned during ongoing decommissioning activities.
52. The current report is the first of a five-yearly cycle in what is in effect an evolutionary process. Future reviews will give the opportunity to consider the effectiveness of UCL's review processes; to report the extent to which UCL has made progress in refining its strategies and plans; to examine the continued validity of UCL's assumptions; and to review the reduction in uncertainties as more decommissioning work is completed. In particular, NII will expect to see work on programmes completed or in hand to address the improvements and enhanced requirements that have been identified in the current report.
53. NII has considered the basis of the building dismantling plans (the centrifuge plants being composed of large numbers of units of the same design, shape etc are very amenable to accurate planning) and discussed areas of potential uncertainty with Urenco decommissioning engineers. In NII's view Urenco have done all that is reasonable in their planning to reduce the waste arisings from dismantling and minimise the liability provision to support waste management and disposal. In addition they have appropriate research and development programmes to make further progress in this regard as experience with decommissioning develops. The position of disposal and transfer authorisations with the Environment Agency has been investigated and no problems for the future have been identified.
54. Initially NII identified some concerns about a possible unrecognised liability for contaminated land, particularly the possibility that prior to the availability of Drigg as a disposal route (late 1950's early 1960's) radioactive wastes might have been disposed of on some part of the site ,prior to UCL's occupation, without authorisation. NII is satisfied that efforts to identify buried wastes and contaminated land have been made and that the liabilities provision for contaminated land is reasonable at the present time. This work should continue. The possible movement of contaminated material from the BNFL site has been considered and accounted for where appropriate. Urenco are aware of the need to consider carefully any contaminated land issues if they seek to acquire land from the BNFL site in the future. In some cases, remediation of contaminated land is covered by lease arrangements with BNFL. NII has concluded that the planning for dismantling, decommissioning, treatment of radioactive materials and waste disposal carried out by Urenco is based on valid assumptions and a sound approach.

## ***Management of Tails Uranium Hexafluoride***

55. UCL's Uranium Hexafluoride Tails Policy is summarised at Annex 1. The following key assumptions have been made by UCL. These are relevant to the strategy for the storage, processing and disposal of Uranium tails and have been drawn from the information reviewed by NII:
- the uranium hexafluoride tails arising from UCL's operations are capable of being used again as a feedstock for an enrichment process, subject to the prevailing economics in terms of the price of feedstocks, the cost of the enrichment process and the value of the resulting product;
  - UCL's contract with Technebexport (TENEX) of Russia, which is used to limit the quantities of tail stocks stored at Capenhurst, is assumed to continue until 2010 and then to cease;
  - tails held outwith the TENEX contract are held as UF<sub>6</sub> until 2020.
  - deconversion to uranium oxide is planned to start in 2020 at a rate of 3,000 tU / annum and continues through to completion of the process in 2053;
  - the strategy document indicated that the deconversion would be undertaken either by a third party under contract or by UCL in a purpose-built facility on its own site;
  - the deconverted material will be safely stored in suitably engineered facilities on the Capenhurst site;
  - the storage period for the uranium oxide is taken to be 100 years, i.e. transfer to the final national repository begins in 2120 and ends in 2153.

The process of deconversion of hex tails to uranium oxide and any associated processing plant will require a BPEO study to be completed and will also necessitate a referral to the Environment Agency's National Waste Assessment Team (NWAT) via the NII for further scrutiny. The suitability of the storage drums for deconverted oxide will need to be justified. All of the assumptions above are under review by UCL as part of the company's ongoing tails management strategy.

56. Excluding high tails material intended for re-feed to the enrichment plant, the tails inventory figure for 31 December 2002 was 5,938 te U. This figure has been used as the basis for calculating UCL's existing liability for the storage, deconversion and ultimate disposal of tails for balance sheet purposes.
57. The UCL Tails Provision Review 2003 provides an overview of the rates of generation of the UF<sub>6</sub> up to the end of enrichment activities, its deconversion to uranium oxide and the transfer of the latter to a repository for final disposal. However the calculation of the cost estimate is confined to existing stocks of tails. UCL has recently addressed this point and will include this aspect in the next QQR review.

## ***Decommissioning***

58. UCL's decommissioning strategy is predicated on the assumption that if enrichment work does indeed cease in 2035 then UCL will find some other - as yet unidentified - commercial use for the site, and that this will support much of the infrastructure costs related to the running of the site. However there can be no certainty about this. An alternative scenario is that if the site has no other viable use when production ceases in 2035 then Capenhurst could become a decommissioning-only site on which:

- dismantling and decontamination of plant and equipment will continue for several years (at least five) after the end of enrichment;
- the dismantling/decontamination facility will itself then need decommissioning;
- the deconversion of UF<sub>6</sub> will continue until at least 2053, on present projections, and will need to be funded accordingly;
- UCL will need to resource the storage of UF<sub>6</sub> and its despatch to a deconversion facility, the subsequent return and storage of uranium oxide, and the eventual despatch of the uranium oxide stocks to the national final repository.
- the transfer to the national repository will not commence until at least 2120 and - on the basis of UCL's assumptions - could continue until 2153;
- until the transfers to the repository have been completed UCL will also need to:
  - maintain an appropriate level of site security, which is likely to necessitate the site being appropriately staffed around the clock for a significant number of years after the end of productive operations;
  - retain a corporate organisation commensurate with the operation of a licensed nuclear site, and in particular maintain its intelligent customer capability;
  - demonstrate its ability to maintain corporate knowledge, including records etc. of operations at the site and the implications for decommissioning and the management of radioactive wastes;
  - meet the regulatory requirements of NII and EA;
  - continue to maintain and operate the site infrastructure, including care and maintenance of roads and buildings, utility costs etc. etc;
  - be able to prepare and update safety cases;

- have the capacity to respond to incidents and to implement appropriate emergency arrangements;
- provide essential services such as health physics;

**Finding No. 6:** Future Liabilities Strategy - For quinquennial review purposes, the decommissioning and tails strategy should be reviewed to encompass appropriate overheads and future liabilities to determine what effect this would have on the acceptability of the current strategy.

59. UCL has recently reviewed arrangements for future storage and deconversion of UF<sub>6</sub> and the subsequent storage and disposal of uranium oxide over a significant number of years as a result of the implementation of its decommissioning strategy.

**Finding No. 7:** Reworking of Tails Estimates - For the next quinquennial review purposes, the tails estimates should be reviewed to cover the whole of the next 150 years to determine what the impact would be on UCL's total liabilities.

**Finding No. 8:** Provision of long term funding - For the purpose of the next quinquennial review, UCL should provide a more robust demonstration that it can generate a sufficient provision by 2035 to cover its decommissioning and waste management liabilities for a significant number of years. UCL should indicate what assumptions underpin this demonstration, including rates of return on investments, arrangements for ensuring continuity of the management of decommissioning and waste management provisions etc.

60. UCL has assumed that the national repository will not become available until 2120, and that uranium oxide will need to be stored at the site for a significant number of years after deconversion. UCL needs to demonstrate that it could adapt its strategy and funding arrangements to cope with disposal, for example, on a shorter timescale.

**Finding No. 9:** Early decommissioning - For the next quinquennial review, UCL should provide a demonstration that its arrangements can accommodate disposal on a shorter timescale.

61. NII has noted that UCL's arrangements for managing its decommissioning and waste management provisions may not comply with the Government policy which suggests that a segregated fund is appropriate for licensees which are not in the public sector;

**Finding No. 10:**

Segregated Funds: - For the next QQR, should review its policy on the management of its decommissioning and waste management provisions in the light of government policy. A decision to opt for a funding mechanism other than a segregated fund should be properly substantiated.

## SUMMARY OF FINDINGS

- Finding No. 1:** Availability of Disposal Routes - UCL to review the dependency upon BNFL disposal routes which may no longer be available after 2006/07.
- Finding No. 2:** ILW Waste Streams - UCL should review the adequacy of existing strategies for conditioning of waste streams and provide evidence of suitable programmes of research and development where appropriate.
- Finding No. 3:** Land characterisation - UCL needs to complete its extended land characterisation studies and develop a contaminated Land Policy.
- Finding No. 4:** Delicensing – UCL should undertake further work as appropriate to determine the sensitivity of provisioning requirements to the assumption on delicensing.
- Finding No. 5:** Records Management – UCL needs to review and strengthen arrangements for the long term retention of records required for radioactive waste management.
- Finding No.6:** Future Liabilities Strategy - For quinquennial review purposes, the decommissioning and tails strategy should be reviewed to encompass appropriate overheads and future liabilities to determine what effect this would have on the acceptability of the current strategy.
- Finding No.7:** Reworking of Tails Estimates – For the next quinquennial review, the tails estimates should be reviewed to cover the whole of the next 150 years to determine what the implications would be on UCL's total liabilities.
- Finding No.8:** Provision of long term funding - For the purposes of the next quinquennial review, UCL should provide a more robust demonstration that it can generate a sufficient provision by 2035 to cover its decommissioning and waste management liabilities for a significant number of years. UCL should indicate what assumptions underpin this demonstration, including rates of return on investments, arrangements for ensuring continuity of the management of decommissioning and waste management provisions etc.

**Finding No.9:**

Early decommissioning - For the next quinquennial review, UCL should provide a demonstration that its provisioning arrangements can accommodate disposal on a shorter timescale.

**Finding No.10:**

Segregated Funds - For the next QQR, UCL should review its policy on the management of its decommissioning and waste management provisions in the light of government policy. A decision to opt for a funding mechanism other than a segregated fund should be properly substantiated.

## References

1. Department of the Environment *Review of radioactive waste management policy : Final conclusions* Cm 2919 HMSO 1995 ISBN 0 10 1291922.
2. Planning Inspector's Report; Application by Magnox Electric plc Snowdonia National Park Authority, Trawsfynydd Nuclear Power Station, Trawsfynydd, Gwynedd, Report APP/H9504/X/02/514182 Welsh Office, HMSO
3. UCL Decommissioning Strategy Summary, Paper Prepared in Support of the 2001 Quinquennial Review, Issue 1, March 2002.
4. Health and Safety at Work etc Act 1974 HMSO 1974 ISBN 0 10 543774 3.
5. Nuclear Installations Act (as amended) 1965 HMSO ISBN 1 10 850216 3.
6. Health and Safety Executive Nuclear site licences under the Nuclear Installations Act 1965 (as amended) : Notes for applicants HSE Books 1994 ISBN 0 7176 0795X.
7. *Radioactive Substances Act 1993* HMSO 1993. ISBN 0 10 541293 7.
8. Bacon, M HSE policy on decommissioning and radioactive waste management at licensed nuclear sites Nuclear Energy 1997 36 13-19.
9. International Atomic Energy Agency *Factors relevant to the decommissioning of land based reactor plants* Safety series 52 IAEA 1980 ISBN 92 0 623080 8.
10. Nuclear Energy Agency *The Safety of the Nuclear Fuel Cycle* NEA/OECD 1993 ISBN 92 64 13824 2.
11. International Atomic Energy Agency *Principles for the safe management of radioactive waste* Safety series 111-F IAEA 1995 ISBN 92 0 103595 0.
12. International Atomic Energy Agency *Regulatory process of the decommissioning of nuclear facilities* Safety series 105 IAEA ISBN 92 0 123690 5.
13. House of Lords Select Committee on Science and Technology *Management of nuclear waste* 3<sup>rd</sup> report Stationery Office 1999 ISBN 0 10 404199 4.
14. UK National consensus conference on radioactive waste management, Westminster Central Hall, London 21-24 May 1999, Final Report UK Centre for Economic and Environmental Development ISBN 0 9487 2931 7.

## ***Glossary of terms***

BNFL	British Nuclear Fuels plc.
BNFL sites	Calder Hall, Capenhurst, Chapelcross, Drigg, Sellafield and Springfields.
BPEO	Best Practicable Environmental Option.
BRIMS	British Radwaste Information Management System: a database of UK radioactive waste storage funded by the industry, the HSE and government.
DfT	Department for Transport.
DTI	Department of Trade and Industry.
EA	The Environment Agency.
ET UK	Enrichment Technology (UK) Ltd.
Facilities	Plant, process equipment, stored radioactive material and contaminated items.
FRS	Financial Reporting Standard.
Hex	Uranium Hexafluoride.
HSE	Health and Safety Executive.
HSW74	Health and Safety at Work etc Act 1974.
IAEA	International Atomic Energy Agency.
ILW	Intermediate Level Waste: waste with radioactivity greater than LLW but the heat it generates is insufficient to affect the design of storage facilities.
Licensee	Holder of a nuclear site licence
LLW	Low Level Waste: radioactive waste inappropriate for disposal with ordinary refuse but with specific activity not greater than 4 GBq/te alpha or 12 GBq/te beta/gamma.
NDA	Nuclear Decommissioning Authority.
NEA/OECD	Nuclear Energy Agency / Organisation of Economic Cooperation and Development.
NIA65	The Nuclear Installations Act 1965 (as amended).
NII	HM Nuclear Installations Inspectorate, part of HSE.
Nirex	United Kingdom Nirex Ltd: responsible for providing ILW disposal facilities.
POCO	Post Operational Clean Out.
PSR	Periodic safety review, as required under a condition of the nuclear site licence.
QQR	Quinquennial Review.
RSA93	The Radioactive Substances Act 1993.
SEPA	The Scottish Environment Protection Agency.
Site	Nuclear licensed site.
TENEX	Technebexport (A Russian company providing enrichment services).
TSW	Tonnes separative work ( a measure of enrichment plant capacity)
UCL	Urenco (Capenhurst) Ltd.
UEC	Urenco Enrichment Company
Urenco	Capenhurst, Gronau and Almelo.
Enrichment sites	
UPD	Urenco Projects Division.

### ***Annex 1 - UCL's Uranium Hexafluoride Tails Policy***

1. UCL safely stores UF<sub>6</sub> which has been generated on the Capenhurst site and makes financial provision for its ultimate disposal.
2. When it is financially viable to do so the Uranium is re-enriched, otherwise UCL will continue to store tails in the form of UF<sub>6</sub> provided that it is safe to do so.
3. UCL has agreed with the NII that UF<sub>6</sub> tails storage limit for the UCL site of 70,000 tonnes of Uranium.
4. When the UF<sub>6</sub> tails stocks reach 50% of UCL's storage limit, UCL will inform the NII and will undertake a formal review of its Policy. The aim of the review will be to have a contract in place by the time that the UF<sub>6</sub> stocks reach 75% of the limit (e.g. for conversion to a more stable form or for re-enrichment), to ensure compliance with the UCL limit.
5. When the UF<sub>6</sub> tails stocks reach 75% of UCL's limit, UCL will inform the NII of its contractual arrangements for ensuring continued compliance with the UCL limit.
6. UCL will store any converted Uranium tails on the Capenhurst site in a retrievable form in a properly engineered facility, until it is either re-used or all further possibility of economic use has been ruled out and a final disposal site has been commissioned by the UK Government.
7. UCL will review its Policy continuously to take account of relevant technological advances and social and economic issues. Unless any of these issues warrant an earlier review, the next formal review of the policy will occur in the year 2004, by which time UCL's stocks of UF<sub>6</sub> tails will not be approaching the criteria specified in point 4 above.

***Annex 2 – HSE’s Summary of Decommissioning Activities and Liabilities relating to Urenco (Capenhurst) Ltd***

- dismantling and decontamination of plant and equipment will continue for several years after the end of commercial enrichment operations.
- a dismantling/decontamination facility will need to be designed, constructed, installed and then itself decommissioned since none currently exists, or suitable alternative arrangements made.
- UCL own significant stocks of depleted uranium hexafluoride which are stored at Capenhurst. Deconversion of tails uranium hexafluoride to a more passive, stable form will be a significant on-going activity. This will either require a new dedicated facility on site or commercial arrangements with a supplier of deconversion services.
- the storage, packaging, transport and eventual disposal of uranium oxide arising from the deconversion of tails uranium hexafluoride.
- site characterisation and remediation leading to the eventual delicensing of the site.
- the site management liability incurred in a post-operational phase .

***Annex 3 – UCL Decommissioning Strategy Paper***

**URENCO (CAPENHURST) LIMITED**

**UCL DECOMMISSIONING STRATEGY  
SUMMARY PAPER PREPARED IN SUPPORT OF  
THE 2001 QUINQUENNIAL REVIEW**

<b>Prepared by:</b>	Nuclear Licensing Manager Manager EH&S Department
<b>Approved by:</b>	Managing Director
<b>Issue No.</b>	1
<b>Date:</b>	March 2002
<b>Review date:</b>	February 2007

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## **EXECUTIVE SUMMARY**

The following report details the decommissioning strategy for the Urenco (Capenhurst) Limited (UCL) nuclear licensed site and has been prepared in response to a request from HM Nuclear Installations Inspectorate.

The strategy identifies the expected methods and timescales for decommissioning the site, based on UCL's decommissioning experience to date. However, it is recognised that some details may change as a result of possible changes in the political, economic and commercial situation.

It is also expected that the exact method of decommissioning may change with time as more experience is gained within the Urenco Group and also, across the industry. At the time of decommissioning, the best available techniques will be employed to reduce the duration, impact and where possible, the cost of the decommissioning process.

Due to the nature of the operations undertaken at UCL and the decommissioning experience gained to date, it is not expected that decommissioning will be difficult to achieve. Wastes generated by the decommissioning will generally be low level and it is anticipated that contaminated land will be minimal.

The strategy provides the high level decommissioning process to be utilised. As the time approaches for the decommissioning work to be undertaken, detailed safety cases and programmes of work will be prepared in accordance with defined arrangements to support and control the work.

A review of UCL's strategy for decommissioning and the total cost estimate of its decommissioning liabilities is undertaken on an annual basis and the findings are reported to the UCL Executive Committee.

## 1. INTRODUCTION

THE 1995 White Paper Cm2919 'A Review of Radioactive Waste Management Policy : Final Conclusions' states that the Government would ask all nuclear operators to draw up strategies for the decommissioning of their redundant plant and that the Health and Safety Executive would review these strategies on a quinquennial basis, in consultation with the Environment Agency.

The following document provides a summary of the decommissioning strategy for Urenco (Capenhurst) Limited and has been prepared for submission to the Nuclear Installations Inspectorate and the Environment Agency.

## 2. BACKGROUND

Urenco (Capenhurst) Limited (UCL) is the UK subsidiary of Urenco Ltd, a British-German-Dutch organisation which operates uranium enrichment plants using gas centrifuge technology. Urenco supplies a uranium enrichment service to nuclear power station operators world-wide. The Head Office of Urenco Ltd is at Marlow, Buckinghamshire, where marketing and sales staff are located. The organisation has three enrichment sites - at Gronau in Germany, at Almelo in the Netherlands and at Capenhurst, near Chester, in the UK.

UCL is a nuclear licensed site, which was formed in March 1993 after a transfer of undertakings from part of BNFL. UCL embraces a number of activities in addition to operating enrichment plants. It provides the design, engineering and decommissioning expertise for the Urenco Group and it is also developing new business opportunities for products evolved from its core skills and technology. UCL employs ~450 personnel supported by a number of contractors working on the site on design and construction projects. There is also a facilities management contractor with ~35 employees on site.

BNFL still operate on part of the Capenhurst site under a separate Nuclear Site Licence. Although the two companies are independent they co-operate, through inter-company service agreements, to provide each other with a number of services (e.g. UCL health physics services to BNFL and BNFL waste disposal services to UCL) and also come together to implement the joint emergency procedures for the combined Capenhurst site.

UCL currently operates three centrifuge plants (E22, A3 and E23) and a small number of contaminated facilities in support of the centrifuge plants (e.g. maintenance workshop and analytical laboratories).

The present enrichment capacity is ~2300 tonnes separative work. Additional enrichment capacity is currently being installed in the E23 Plant. Assuming that this is completed as planned, the enrichment capacity will rise to ~2880 tSW in 2005.

Since its formation in 1993, UCL has successfully completed the decommissioning of the K Bay technology demonstration centrifuge pilot plant and the E21 commercial demonstration centrifuge enrichment plant. Both of these projects have been completed to time and cost.

In addition, the decommissioning of the redundant plant and equipment from the historic Research and Development Facility is nearing completion. The planned completion date is mid 2002.

The depleted Uranium Hexafluoride, known as tails, which arises from the enrichment process is taken off in internationally approved 48 inch type cylinders and transferred to on site storage rafts. Currently there are three such rafts, rafts 6, 7 and 8, which together have a storage area of 10,464 sq.m. At a working site (i.e. readily accessible) packing density these rafts can accommodate 2004 cylinders. A further storage raft is in the final stages of construction on the site of the previous E21 Centrifuge Enrichment Plant.

In addition to the storage of tails in type 48 containers, UCL also stores a small quantity of tails in type 0236 containers from historic operations. At the end of 2001, UCL's tails inventory amounted to ~5700 te U stored in ~630 type 48 cylinders and 435 type 0236 cylinders.

UCL has an ongoing contract, up for renewal in 2004, with Technebexport of Russia, which takes ex UCL tails cylinders and re-enriches the material to low enrichment product and/or pseudo natural. The product is sold on and the pseudo natural is refed or sold on. The operation of this contract is currently reducing the net tails stocks on Capenhurst site.

### **3. DECOMMISSIONING POLICY**

#### **3.1 Urenco Group Decommissioning Policy (as adopted by all partner sites, including UCL)**

The policy on decommissioning of Urenco Centrifuge plants covers two distinct areas of work.

The removal, decontamination and disposal of contaminated plant and equipment, including centrifuges, to comply with appropriate licensing authority requirements.

The removal and disposal of non-contaminated plant and equipment and the requirement to leave the building structure to meet Urenco's future needs.

The decommissioning of contaminated plant will be undertaken as soon as is reasonably practicable after the cessation of operations having regard to the resources required to undertake the work. The cost of this part of the work will be made from the provisions in the accounts of the operating company. This includes the removal, decontamination and disposal of all radioactive equipment and material, to comply with the appropriate licensing authority requirements.

The decommissioning of non-active plant will be as soon as appropriate after the cessation of operations having regard to the cost and resources required, the work that might be needed in support of active decommissioning and the future needs of the operating company. The cost of this part of the work will be made from the company's annual operating budget.

The future use of the building will be considered against Urenco's business needs outlined in the company plan. This will enable the degree of non-active decommissioning to be defined as well as the infrastructure (electric power, heating, light, equipment etc.) that should be left for future use. In the event that no definitive future use is identified, the objective will be to leave a clean and empty building, which may be used later or sold/rented for non-nuclear work.

All decommissioning programmes will be undertaken as Engineering Projects by Urenco Projects Division (UPD). A decommissioning methodology and plan for each plant will be developed by UPD in conjunction with the operating company. Project management will be undertaken by UPD with decommissioning work being carried out by local management and labour or sub-contractors as appropriate.

### **3.2 UCL Uranium Tails Storage Policy**

#### **Aims of the Policy**

UCL's Uranium storage policy, provided below, subscribes to the principles of sustainable development. The aim of the policy is to provide for the long term safe storage of Uranium tails in the form of  $UF_6$  tails (or a more stable form), which is in a retrievable form, pending re-enrichment and to re-enrich the depleted Uranium tails when it is financially viable.

The Uranium tails will be disposed of when all further possibility of economic use has been ruled out and a final disposal site has been commissioned by the UK Government.

#### **Policy**

- UCL safely stores  $UF_6$  tails which has been generated on the Capenhurst site and makes financial provision for its ultimate disposal.
- When it is financially viable to do so the Uranium is re-enriched. Otherwise UCL will continue to store tails in the form of  $UF_6$  provided that it is safe to do so.
- UCL has agreed with the regulator a  $UF_6$  tails storage limit for the UCL site of 70000 tonnes of Uranium.
- When the  $UF_6$  tails stocks reach 50% of UCL's storage limit, UCL will inform the regulator and will undertake a formal review of its policy. The aim of the review will be to have a contract in place by the time that the  $UF_6$  tails stocks reach 75% of the limit (e.g. for conversion to a more stable form or for re-enrichment), to ensure compliance with the UCL limit.
- When the  $UF_6$  tails stocks reach 75% of UCL's limit, UCL will inform the regulator of its contractual arrangements for ensuring continued compliance with the UCL limit.
- UCL will store any converted Uranium tails on the Capenhurst site in a retrievable form in a properly engineered facility, until it is either re-used or all

further possibility of economic use has been ruled out and a final disposal site has been commissioned by the UK Government.

- UCL will review its policy continuously to take account of relevant technological advances and social and economic issues.

#### **4. DECOMMISSIONING LIABILITIES**

The major future liabilities of UCL are the decommissioning of the existing centrifuge plants (E22, A3 and E23) and the disposal of the stock of uranium hexafluoride tails owned by UCL if and when it is judged to be of no further economic use.

##### **Decommissioning of Centrifuge Plants and other contaminated land**

Financial provision for the decommissioning of plant is built up over the lifetime of the plant, which for provisioning purposes is deemed to be 12 years from the on line date of the plant.

The liability covered by the UCL decommissioning provision, is to remove, decontaminate and dispose of all Uranic contaminated plant such that the ex plant buildings are left clean and available for general use.

##### **Decommissioning of Uranium Tails**

The tails arisings from the production plants are taken off in type 48 inch cylinders and transferred to on site storage rafts. Currently there are three such rafts, rafts 6, 7 and 8, which together have a storage area of 10,464 sq.m. At a working site (i.e. readily accessible) packing density these rafts can accommodate 2004 cylinders. At the end of year 2001 the tails inventory, including material stored in 0236 type containers was ~5700 teU.

The current sanctioned build up programme for UCL assumed that E23 units A-D are completed, leading to a site capacity of 2880 tSW/annum at the end of 2005. The capacity is then allowed to reduce assuming a 30 year lifetime, except for those units with an identified shorter lifetime, with a cessation of all operations by 2032. (N.B. the prospect of an E23E unit extension is currently under discussion, but has not been granted financial sanction at the time of preparing this report.)

Tails arisings are assumed to develop at a rate of 1.65 times the separative work. The few returns to customers are neglected.

UCL has an ongoing contract, up for renewal in 2004, with Technebexport (TENEX) of Russia, which takes ex UCL tails in type 48 inch cylinders and re-enriches the material to low enrichment product and/or pseudo natural. The product is sold on and the pseudo natural is refed or sold on. The operation of this contract is currently reducing the net tails stocks on Capenhurst site. The TENEX contract is assumed to continue at an average annual rate of 3500 tU/annum up to and including 2010 and then to cease.

Financial provision for the disposal of the site tails arisings is made up over the operating life of the plants.

The liability covered by the tails disposal provision is to deconvert to U308 at such a time as this is required by UCL Uranium Tails Policy, to store any converted Uranium tails on the Capenhurst site in a retrievable form in a properly engineered facility, until it is either re-used or all further possibility of economic use has been ruled out and a final disposal site has been commissioned by the UK Government.

Each year usually in May, that years estimate is submitted to the UCL Executive for endorsement.

## 5. PROVISION PROCESS

### 5.1 Cost Estimate

Each year, in the Spring, the cost of decommissioning the UCL centrifuge plant capacity existing at that time is estimated. The estimate also covers any Uranium contaminated plant outside of the main centrifuge plants, for example Research and Development facilities, contaminated maintenance workshops and laboratories etc.

The estimate is performed by the cost engineering section of the Urenco Project Division (UPD), located at the Capenhurst site.

Each year the estimate is adjusted for any plant which has been decommissioned and for any new plant which has been commissioned in that year and for that years price escalation. The estimate is set at first of January money values.

Once complete, the estimate is passed to the Finance Department who build the revised figures into the company provision.

Periodically, the estimate is re base lined back to a new first principles estimate. This exercise was carried out in 1995, in 2000 and will be repeated in 2005, unless circumstances require this review to be undertaken on an earlier timescale.

Each year, usually in May, that years estimate is submitted to the UCL Executive for endorsement.

Each year in the Spring the cost of disposing UCL tails stock is reviewed. The estimate is adjusted for escalation and is re base lined periodically at a time interval of not less than five years and not greater than ten years.

There are four main areas determining the costs and affecting the timing of its execution, these being:

- storage as UF<sub>6</sub>
- deconversion to U308
- retrievable (above ground) managed storage of U308 for 100 years
- final disposal in UK national repository.

Once complete, the estimate is passed to the Finance Department who build the revised figures into the company provision.

## 5.2 **Provision**

In accordance with the URENCO Group Decommissioning Policy, UCL will decommission plant as soon as possible after it is shut down. To meet the eventual costs of decommissioning it is necessary to build up the provision over the economic life of the asset (in line with the depreciation policy, which is that the decommissioning funds are built up, for each plant, over a twelve year period from the on line date of the plant).

The level of provision shown in the Annual Report and Accounts reflects the full liability for all plant in operation, discounted at 2% per annum, after taxation, to take account of the time value of money, in accordance with industry practice, based on the available technical assessments contained in UPD's annual review to the UCL Executive. At 31/12/2001 this was £40,831,000. The accounting Policy for the treatment of the decommissioning provisions is in line with the requirements of Financial Reporting Standard 12 - 'Provisions, Contingent Liabilities and Contingent Assets'. The provisions exercise, from UPD's estimate through to calculation of the level of provisions shown in the annual accounts, are audited by the company's auditors as part of their year end exercise.

The enrichment process generates depleted Uranium Hexafluoride (tails) as a by-product. The company will use all efforts to seek out technical and commercial possibilities to utilise any fissile components still remaining in the tails, including further enrichment.

Provision has been made for all estimated costs and for the eventual disposal of tails. The costs take account of re-enrichment, conversion of tails to a different chemical state, intermediate storage, transport and safe disposal.

As much of the expenditure involved may take place in the future, the provision has been discounted at 2% per annum, after taxation to take account of the time value of money, in accordance with industry practice. At 31/12/201 this was £23,248,000. The accounting Policy for the treatment of the tails decommissioning provisions is in line with the requirements of Financial Reporting Standard 12 - 'Provisions, Contingent Liabilities and Contingent Assets'.

The provision assumptions are as follows:

- tails are held as UF<sub>6</sub> until 2020
- deconversion starts in 2020 at a rate of 3000 tU/annum through to 2042
- the volume of deconverted material will be stored in suitably engineered facilities on the Capenhurst site from the receipt date of each drum of U308
- transfer of U308 to the final repository begins in 2120 and ends 2142.

(At 31/12/01 the provisions for all decommissioning liabilities (centrifuge plant, other contaminated plant and hex tails disposal), was £64,079,000.)

## 6. PROGRAMME, PLAN AND ORGANISATION

### 6.1 Programme

The programme for the decommissioning of the main centrifuge plants at UCL is determined by the economic life of the machines. That is a plant will be taken out of operation when the separation achieved by that plant has fallen to such a level that it is no longer economic to operate it.

Economic machine lifetime is determined by a standing URENCO Group Committee, the Plant Capacity Working Group (PCWG). Each year the PCWG issues a summary report, which amongst other items, provides prospective plant shutdown dates. The PCWG operates on a ten year planning horizon. The current report predicts no large scale shutdown of centrifuge plant capacity at UCL in the next ten years.

The programme for the deconversion of UCL tails stocks is based on the following assumptions:

- The Tenex contract runs until 2010
- Tails are held at UF<sub>6</sub> until 2020, with deconversion commencing in 2020 at a rate of 3000 tU/annum through to 2042
- The volume of deconverted material will be stored in suitably engineered facilities on the Capenhurst site from the receipt date of each drum of U308
- Transfer of U308 to the final repository begins in 2120 and ends 2142.

### 6.2 Plan

The programme for the UCL decommissioning campaign, updated yearly from the PCWG report as described in section 6.1 above, will give early and timely indication of a forthcoming decommissioning campaign.

Each decommissioning campaign will be managed as a project by UPD, which is accredited to ISO 9001 for the management of decommissioning projects.

A decommissioning campaign will therefore be characterised by all the attributes of a project, including:

- a cost estimate against a defined project scope
- a programme
- a project structure with defined roles, resourced by suitably qualified and experienced persons
- project quality plan
- budget
- cost control

- waste management plan
- safety case
- training plan etc.

Experience to date has demonstrated that the start to finish time of a project to decommission a commercial size centrifuge plant is of the order of five years, that is much shorter than the ten year planning horizon. Consequently, a sufficient time frame is always available to instigate the necessary arrangements for a decommissioning project in good time for the next campaign.

This strategy is supported by the required funds being available in the provision and by the assumed best practice methodology being available in the base line estimate assumption.

The decommissioning activities themselves will be resourced as follows. The POCO, radiological characterisation and in situ dismantling will all be performed by UCL personnel. The subsequent component dismantling and decontamination and disposal activities will be performed by one of two options. Either the work will be contracted out to BNFL or the work will be carried out by a contract workforce in a purpose built facility on the Capenhurst site. The UCL decommissioning provision provides for both possibilities and the choice will be made at the time of the project.

This then is the basic plan for decommissioning contaminated plant at UCL.

The programme for tails deconversion, as set out above, is a long range plan. The commencement of tails deconversion is sensitive to the continuation of the Tenex contract. The average rate of tails accumulation on the site, assuming no Tenex contract, is over the next ten years is some 4500 te U per annum. As compared with the holding at the theoretical termination of the Tenex contract, less than 10,000 te U tails, there is a buffer period of in excess of ten years in which to put a deconversion project into position. This time period is fully adequate to make all preparations.

The tails deconversion campaign will be run as a project, being characterised by typical project attributes as discussed above.

### 6.3 **Organisation**

The site Managing Director, as Licensee, is responsible for decommissioning. Authority to execute the decommissioning is delegated to the UPD project manager who then sets up a project in accordance with UPD management systems, as noted above. Prior to the commencement of the decommissioning project, ownership of the shutdown plant is transferred to the project manager.

The site Managing Director is responsible for execution of the tails disposal policy. Authority to execute the tails disposal is delegated to the UPD project manager who then sets up a project in accordance with UPD management systems, as noted above.

## **7. METHODOLOGY**

### **7.1 Dismantling**

#### **7.1.1 POCO**

Following shutdown of the plant the first activity is Post Operational Clean Out (POCO). This procedure degasses the plant, removing all traces of Uranium Hexafluoride gas. All UF<sub>6</sub> cylinders are also removed. All non Uranium bearing chemicals and process fluids e.g. circulating water, compressor oil etc. are also removed. Additionally all Uranium bearing chemicals e.g. charcoal, are removed. The POCO is really a final continuation of standard operational practices and is performed by the plant operations crew as their last job before leaving the plant.

Disposal routes for POCO are in the main provided for by way of the existing routes to support ongoing operations.

The plant will be left at atmospheric pressure, padded with dry nitrogen at the end of the POCO.

#### **7.1.2 Radiological Characterisation**

Prior to the commencement of any further dismantling the plant is radiologically characterised by Health, Safety and Environment Department and Chemistry Services.

#### **7.1.3 In Situ Dismantling non contaminated Plant**

Non contaminated plant will be dismantled in situ by conventional dismantling / construction techniques. The work will be supported by an overall safety case and specific method statements as appropriate.

Consignments will be either to scrap companies for material recycle or to waste disposal companies for land burial. In all cases the companies will have been reviewed by the UCL Nuclear Safety and Environmental Manager, or his nominated deputy, to confirm the companies being used possess the correct authorisations and permits.

All consignments leaving the site will be subjected to a radiological monitoring regime, and a certificate will be required to allow the consignment to be moved.

The radiological monitoring service will be supplied by the UCL HSE department who operate independently of the project.

#### **7.1.4 In Situ dismantling contaminated Plant**

Contaminated plant will be degassed and radiologically and chemically checked for airborne contamination prior to break in for dismantling. Urenco possess proven working methods which allow for contaminated plant to be dismantled in situ with

effective containment of radioactive contamination. Using these techniques the plant will be dismantled in situ in readily manageable sections. The centrifuge machines themselves will be removed from the plant intact.

The dismantled components will be transferred to a decontamination plant, see section 7.2 below.

## 7.2 **Decontamination**

The decommissioning provision provides for two alternative approaches to the decontamination of the contaminated plant components, once they have been removed from the plant. Either the task can be contracted to BNFL or a purpose built facility will be provided on the UCL site. In the latter case this facility will be operated by a contract workforce, under the control and supervision of UCL.

The process in the UCL facility, should this option be chosen, will comprise:

- A buffer storage area, with appropriate criticality safety controls, will be provided to hold the ex plant components prior to processing.
- Some components e.g. simple large bore pipe sections will be suitable for direct introduction into the decontamination process. For this purpose a decontamination train with degreaser, acid dip baths, rinse baths and final monitoring station will be provided.
- Other components e.g. centrifuge machines will require sub dismantling prior to introduction into the decontamination train. For this purpose a dismantling train with glove boxes, contaminated ventilation systems and volume reduction machines etc. will be provided.
- The output of this facility will be made up of several streams discussed in section 8 below “waste management”.

## 7.3 **Development**

The decommissioning cost estimate is robust in the sense that at any point in time it is based on proven processes. The cost estimate is supported by development work, aimed at both reducing the environmental impact and the cost of the processes. Once a new process is qualified it will be incorporated into the next update of the decommissioning cost estimate.

An example of this is work currently underway to optimise the treatment of the latest rotors. The latest rotor material does not decontaminate down to free release levels in the current decontamination process (citric acid baths). Consequently the current cost estimate assumption is that the rotors are drummed and disposed of to land burial. Work is in hand to investigate the development of new techniques to fully separate the Uranium from the rotors such that the rotors can be disposed of as scrap. The successful development of such a process will therefore yield both cost and environmental benefits.

An important point, therefore, is to note that although main centrifuge plant decommissioning work is not ongoing at this time, process and environmental improvement development work is.

#### 7.4 **Deconversion**

The tails disposal cost estimate is based on deconversion of the UF<sub>6</sub> tails to U308.

The process for deconversion is well established and is described as follows:

- The UF<sub>6</sub> would be vaporised and fed to a rotating kiln in which it would be contacted with superheated steam to form UO<sub>2</sub>F<sub>2</sub> and then U308. The U308 powder will be poured into mild steel drums which are vibrated to increase powder density.
- The kiln off gas passes through a condenser and a twin scrubber in order to remove HF which is a saleable by-product. The recovered HF will be transported from the process by road tanker.

The emptied UF<sub>6</sub> cylinders will be decontaminated, cut up and exported from the plant as scrap.

The interim storage in a site facility will be in the mild steel drums. The material will be stored until it is either re-used or all further possibility of economic use has been ruled out and a final disposal site has been commissioned by the UK Government.

The output of this facility will be made up of several streams discussed in section 8 below, waste management.

There is currently only one company with commercially operating plants: Cogema, with a capacity of 14000 t/annum. These plants are operating fully for Eurodif effectively converting all existing production and reducing the historically accumulated tails.

As an alternative to deconversion by Cogema, the possibility of the construction of a plant in the UK for the deconversion of UCL and BNFL tails has been investigated. A study was undertaken by BNFL Engineering Limited for URENCO Limited in 1998, estimating the capital and operating costs of a plant producing U308 plus aqueous HF.

## 8. **WASTE MANAGEMENT / URANIUM RECOVERY**

### 8.1 **In Situ dismantling streams**

#### 8.1.1 **POCO Streams**

The following streams arise from POCO and make use of the existing waste handling and Uranium recovery arrangements, which support ongoing plant operations. Specifically:

<b>SOURCE OF MATERIAL</b>	<b>DISPOSAL / RECOVERY STREAM</b>
Uranium contaminated vacuum pump oil	Fomblin recovery plant operated by UCL Production Department. Uranic residue recovered to fuel cycle at BNFL.
Scrubber liquor	Free release following satisfactory radiological sampling.
Uranium contaminated Sodium Fluoride	Sodium Fluoride recovery plant operated by BNFL Springfields under established contract.
Uranium contaminated charcoal	Charcoal recovery plant operated by BNFL Springfields under contract. Process currently being developed.
Uranium contaminated Aluminium Oxide	Alumina recovery plant operated by BNFL Springfields under contract.
Reprocessed feed contaminated Magnesium Fluoride	To temporary Intermediate Level Waste (ILW) storage.
Refrigerant gas	Disposal (or recycle as appropriate) via authorised contractor.
Refrigerant compressor oil	Disposal via authorised waste contractor under special waste regulations.
Cooling system water	Free release following satisfactory sampling.
HEPA filters from the Gaseous Effluent Ventilation System	Current disposal arrangements is via BNFL Capenhurst incinerator.
Miscellaneous swabs and wipes	Current disposal arrangements is via BNFL Capenhurst incinerator.
Overalls	Washed/recycled via UCL laundry, contaminated overalls disposed of via BNFL Capenhurst.
Personal Protective Equipment (PPE)	Cleaned/recycled via UCL Health Physics department, contaminated items disposed of via BNFL Capenhurst.

### 8.1.2 Dismantling Streams

These streams arise from the in situ dismantling of the plant. They divide into two main categories, clean and contaminated.

#### 8.1.2.1 Non Contaminated stream

A radiological monitoring regime is set up to characterise the arisings and ensure that all clean components leaving the site are passed radiologically clear. The clean streams will where possible be recycled via a scrap dealer and where this is not possible a suitable waste contractor will be used to dispose of the particular items. In all cases the scrap and waste disposal contractors will be vetted by the Nuclear Safety and Environmental section of Health, Safety and Environment Department in order to ensure the contractors possess the necessary licenses and permits. In some cases it will be necessary to undertake some building and civil demolition to release equipment and these arisings also will be disposed of to a contract firm.

A scrap contract will be set up to take cables and a variety of metals including steel girders etc. This will deal with the bulk of the arisings. Specific contracts will be set up to deal with a variety of other materials e.g. Man Made Mineral Fibre (MMMF), capacitors etc. In the case of building demolition, materials will be disposed of by the demolition contractor as part of his contracted scope of work.

<b>SOURCE OF MATERIAL</b>	<b>DISPOSAL / RECOVERY STREAM</b>
General scrap including cables and metals	Recycled into market via scrap contractor.
Special materials e.g. MMMF, capacitors	Land disposal via case specific arrangements.
Building materials	Disposed of via demolition contractor.

#### 8.1.2.2 Contaminated Stream

The contaminated stream produced by the plant decommissioning activities will be the feed stream for the dismantling and decontamination facility, or dismantling and decontamination contract.

The contaminated steam will comprise exclusively sealed pipe sections, sealed desublimers, sealed valve consoles and hotboxes, and sealed centrifuge machines. Sealed refers to the sealing of open pipe ends on all components such that they can be transported without risk of contamination spread.

<b>SOURCE OF MATERIAL</b>	<b>DISPOSAL / RECOVERY STREAM</b>
Pipe sections, desublimers, valve consoles and hotboxes	Dismantling and decontamination facility (or contract).
Centrifuge machines	Dismantling and decontamination facility (or contract).

## 8.2 Dismantling and Decontamination Facility Streams

The dismantling and decontamination streams are in two categories, non-contaminated and contaminated.

The non-contaminated stream will be almost exclusively made up of process plant metals which have been decontaminated to free release levels in the decontamination baths. These components will be mainly large bore process pipe and centrifuge casings.

The contaminated streams will arise from several sources and fall into, again two categories.

The first category will be materials for which the decontamination plant has been unable to achieve free release levels although a significant reduction in Uranium loading will have been made. These arisings will have to be consigned to Low Level Waste (LLW) storage.

The second category of material will be components for which decontamination cannot be achieved in an ALARP manner. For example very thin bore pipework for which the process cannot circulate decontamination fluid and for which there is no technique to monitor the internal surface of the pipework. In these cases the assumed technique is volume reduction followed by disposal to a LLW depository.

Finally the Uranium separated in the decontamination facility will be recycled into the fuel cycle via a contract with BNFL Springfields.

The waste streams are therefore shown in the following table.

<b>SOURCE OF MATERIAL</b>	<b>DISPOSAL / RECOVERY STREAM</b>
Cleaned material	Recycled into market via scrap contractor.
Cleaned but trace contaminated	LLW depository.
Components remaining contaminated under ALARP argument	LLW depository.
Recovered Uranium	Returned to the fuel cycle via contract with BNFL Springfields.

### 8.3 Tails Deconversion Streams

The 48 inch cylinders are connected to the deconversion plant and emptied via steam autoclaves to the kilns, where the hex stream is counter flowed with steam to produce Uranium Trioxide. Once the 48 inch cylinders are empty, they are washed out and cut up for scrap. The process generates no liquid effluents, the kiln condensate is combined with scrubber off gas liquor to form the saleable by-product Hydrofluoric acid. The autoclave steam is recycled within a closed system and the hex cylinder wash liquor is re-fed to the kilns as steam.

The main process arisings are therefore:

<b>SOURCE OF MATERIAL</b>	<b>DISPOSAL / RECOVERY STREAM</b>
Uranium in the form of U308	On site storage in mild steel drums, in a retrievable form until the material is either re-used or all further possibility of economic use has been ruled out and a disposal site has been commissioned by the UK Government.
Cylinders	Decontaminated steel recycled as scrap.
Cylinder valves	Decontaminated and recycled as scrap.
Miscellaneous swabs and wipes	Current disposal arrangements is via BNFL Capenhurst incinerator.
Overalls	Washed/recycled via UCL laundry, contaminated overalls disposed of via incineration at BNFL Capenhurst.
Personal Protective Equipment (PPE)	Cleaned/recycled via UCL Health, Safety and Environment Department, contaminated items disposed of via incineration at BNFL Capenhurst.

## 9. **SITE REMEDIATION**

The Urenco (Capenhurst) Limited site is considered to be in the main free of land contamination problems.

Prior to the establishment of the centrifuge plants on the half of the site that is now operated as the UCL Nuclear Licensed Site, there had been little development of the site. This fact, combined with the hydrology of the site provides a level of confidence that there are no significant areas of contaminated land on the land owned by UCL.

A survey of the site was undertaken in support of the restructuring of the site. This survey did not reveal any significant areas of contamination. In addition, a desk top review of potentially contaminated land on the combined Capenhurst site, undertaken in collaboration with BNFL Capenhurst in 2001, provided further support.

The area of land under the A3 Centrifuge Plant, which although leased from BNFL Capenhurst currently forms part of the UCL nuclear licensed site, is known to be contaminated. The decommissioning liability for this contaminated land is the responsibility of BNFL Capenhurst, as detailed in the lease agreement.

UCL has given a commitment to NII to develop a Contaminated Land Policy. This policy will detail the strategy for managing any contaminated land discovered.

## **10. UCL HEALTH SAFETY AND ENVIRONMENTAL MANAGEMENT SYSTEM**

UCL has a Health, Safety and Environmental Policy statement which embodies the principles and objectives of the Urenco Ltd Group HSE Policy. The Policy was developed through a process of consultation with consideration of the Policy at a number of company health, safety and environmental committees, prior to submission to the UCL Executive for formal endorsement. The HSE Policy fulfils the requirements of section 2(3) of the Health and Safety At Work Act 1974. It is modelled on BNFL's Health, Safety and Environmental Management System.

The Policy statement (see Appendix 1) is widely communicated. It has been published to all employees through the UCL Employee Handbook and is routinely published through copies of the UCL annual HSE Report.

The policy was last formally reviewed in 1998 and is currently under review.

### **10.1 Basis for Health and Safety Standards**

The Health, Safety and Environmental Management system which is described in the Company Health, Safety and Environmental Manual and is based on the BNFL system as set out in their UK Environment, Health and Safety Manual.

### **10.2 Implementation of UCL HSE Policy**

The Policy statement forms the top tier HSE documentation within the Company. The principles embodied in the Health, Safety and Environmental Policy are given substance in the UCL Health, Safety and Environmental Manual. Here standards are defined and supporting advice and guidance is promulgated for transmission through the tiered management structure to ensure that risks to safety, health and the environment are consistently and adequately assessed and controlled, and that protective measures appropriate to the hazard and risk are implemented. Standards and guidance are formulated taking due account of the requirements of legislation and approved codes of practice; British and International Standards such as IAEA Standards, Codes and Guides and HSE Guidance such as Safety Assessment Principles for Nuclear Plants, and Successful Health and Safety Management

(HSG 65). UCL also considers the BNFL UK Environment, Health and Safety Management System, and adopts these arrangements where relevant. The requirements of the UCL HSE Manual are implemented on site via mandatory Safety Instructions.

For each tier of the system, there exists the following key features:

- **Policy:** The health, safety and environmental policy appropriate to that tier
- **Organisation:** The definition of responsibilities and delegation of accountabilities for health, safety and environmental, arrangements for provision of specialist advice and the establishment of supportive advisory departments and committees.
- **Planning and Implementation:** The establishment of a management process to achieve health, safety and environmental requirements in practice.
- **Measuring Performance:** Systems for the routine management review of the adequacy and implementation of the Health, Safety and Environmental Management System.
- **Audit and Review:** A systematic review of performance based on data from monitoring and from independent audits of the whole Health, Safety and Environmental Management System.

## **11. EXPERIENCE TO DATE**

Experience within the Urenco group of companies exists in all areas of centrifuge plant decommissioning. At UCL in situ dismantling has been conducted on the K Bay technology demonstration pilot plant and on the E21 commercial demonstration plant. Both these jobs were carried out to time and cost.

At the Almelo site, occupied by the Dutch operating company, both in situ dismantling and subsequent sub dismantling and decontamination work is proceeding. This latter work is in respect of both plant components and centrifuge machines. Again the work is being conducted to programme and cost.

The decommissioning provision cost estimate is therefore supported by real decommissioning experience.

## **12. SITE CLOSURE**

Urenco's current contracted business orders extend well beyond 2010. In addition, based on past experience there is a high degree of confidence that the existing contracts will be renewed and that the business will expand rather than contract.

However, in the unlikely event of site closure, as stated in the URENCO Group Decommissioning Policy, the declared end point would be to:

- Undertake the removal, decontamination and disposal of contaminated plant and equipment, including centrifuges, to comply with the appropriate licensing authority requirements.
- Undertake the removal and disposal of non contaminated plant and equipment and to leave the building infrastructure such that it can be released for unrestricted use.

In addition, sufficient radiological characterisation and where necessary, clean up, of the land would be undertaken to confirm that the land met the criteria for unrestricted use. Where surveys exist of the land prior to the establishment of the nuclear facilities at UCL, these will form the basis of demonstration that no radiological hazard exists following decommissioning.

### 13. **UNCERTAINTIES AND THEIR RESOLUTION AND REMOVAL**

The main uncertainties are as follows:

- The timing of decommissioning campaigns
- The continued availability of the BNFL contract for the treatment, decontamination and disposal of centrifuge components
- The future availability of radioactive waste transfer routes
- The future availability of process arisings treatment/recovery routes
- The long term cost of low level waste disposal
- UCL Tails Deconversion/disposal.

#### 13.1 **Timing of Campaigns**

The main uncertainty in the UCL decommissioning programme is the timing of the campaigns. The decommissioning funds are built up, for each plant, over a twelve year period from the on line date of the plant. The ultimate life limiting factor of each centrifuge type, post the twelve year design lifetime, is however not easily predicted. For this reason the timing of the next decommissioning campaign (E22A) at Capenhurst is somewhat uncertain and in any case is not anticipated before the early part of the next decade. In that the decommissioning costs are provided for, this uncertainty does not need to be otherwise addressed.

#### 13.2 **BNFL Contract for the treatment, decontamination and disposal of centrifuge components**

UCL currently has a contract with BNFL for the treatment, decontamination and disposal of centrifuge components. The current contract provides for this service/activity to be undertaken at BNFL Capenhurst.

Recognising that declared future activity of the BNFL Capenhurst site as a uranic storage site, following the successful completion of the Integrated Decommissioning Programme, the contractual agreement with BNFL provides for a parent body guarantee agreement.

As such, in the event that the BNFL Capenhurst facilities are unable to complete the work, BNFL will make arrangements for some other BNFL facility to take ownership of UCL arisings under the contract, such that all of the conditions of the contract can be honoured.

Whilst this is an uncertainty, UCL has undertaken a decommissioning provision estimate for a UCL stand alone dismantling and decontamination facility. Current UCL decommissioning provisions are in line with this assessment.

In addition, the contractual agreement with BNFL for the treatment, decontamination and disposal of centrifuge components, provides for all information, reports, drawings, design and other results arising from the work undertaken in support of the contract to become the property of UCL. In particular, the intellectual property shall include details of relevant dismantling techniques and information regarding the quantities, character and locations of contamination found on the centrifuges.

As such, in the event that BNFL Capenhurst is no longer able to provide this service, UCL is confident that sufficient options exist to enable the decommissioning liabilities to be addressed.

### **13.3 Future Availability of Waste Transfer Routes**

Currently Inter Site Transfer Authorisations exist for the transfer of liquid and solid radioactive wastes to BNFL Capenhurst. Depending on the nature of the solid radioactive waste, BNFL onwardly dispose of the waste via incineration or transfer to Clifton Marsh or Drigg.

Again, recognising that declared future activity of the BNFL Capenhurst site as a uranic storage site, following the successful completion of the Integrated Decommissioning Programme, these routes may no longer be available.

However, given that the wastes arising from decommissioning are equivalent in type to the wastes arising from routine operations, there is confidence that if the current routes cease to be available, alternative routes will have to be established for operational purposes and these routes will also service the decommissioning arisings.

Preliminary discussions have been held with the Environment Agency regarding the requirement for UCL to have new RSA 93 Authorisations. Further discussions will be held in 2002.

### **13.4 Future availability of process arisings treatment/recovery routes**

Again, routes currently exist for the treatment/recovery of process arisings (e.g. Uranium recovery from contaminated Sodium Fluoride via BNFL Springfields). The current contracts in support of the above activities are due to expire in 2005. UCL's

aim is to renew these contracts, but this will be dependent on BNFL Springfields willingness/continued availability to provide such services.

### **13.5 The long term cost of low level waste disposal**

The uncertainty in the long term Low Level Waste disposal cost is addressed in two ways, firstly at each cost estimate review the up to date figures are obtained to ensure that the estimate is correct. Secondly, large arisings for ground burial are targeted in the plant R&D programme e.g. rotor decontamination.

### **13.6 UCL Tails Deconversion/disposal**

The main uncertainty in the UCL Tails disposal project is the longevity of the Tenex contract. However, this uncertainty is self correcting in reality because from any point in time that the Tenex contract stops there is a fully adequate buffer period in which to activate the UCL tails policy.

## **14. MAINTAINING CORPORATE KNOWLEDGE**

UCL's arrangements for compliance with nuclear site licence condition 6 require that all safety case documentation, including that prepared in support of the decommissioning of a plant/facility, be retained for a period of 30 years following final decommissioning of a plant/facility.

In addition, corporate decommissioning knowledge is available within the Urenco Group of companies and is arranged in the following manner.

Urenco Projects Division (UPD), which is within Urenco (Capenhurst) Ltd (UCL) has the two decommissioning responsibilities. These are firstly to provide a cost estimate of the group decommissioning monies (including UCL), this cost estimate is updated yearly and is supported by a methodology paper. Secondly, the development of decommissioning techniques is undertaken by the plant R&D section of UPD. The above noted activities are ongoing year on year, thus resulting in retained corporate decommissioning knowledge within the group projects office, UPD.

Additionally it is current experience that decommissioning activities are taking place on at least one site within the group at all times. This situation is planned to continue into the foreseeable future. To date decommissioning activities have been conducted at UCL (K Bay, E21 and C15) and activities are currently ongoing at Almelo in the Netherlands (SP2 plant with SP3 commencing in 2003). Consequently actual "hands on" experience is retained within the group. Complementing the theoretical and estimating experience available in UPD.

The participants of the yearly cost estimate review comprise those persons actively engaged in decommissioning. This experience is harnessed to refine the estimates in the light of experience, to update the methodology paper and to contribute to the plant R&D programme.

Finally, as described in section 13.2 above, the contractual agreement with BNFL for the treatment, decontamination and disposal of centrifuge components, provides for

all information, reports, drawings, design and other results arising from the work undertaken in support of the contract to become the property of UCL. In particular, the intellectual property shall include details of relevant dismantling techniques and information regarding the quantities, character and locations of contamination found on the centrifuges.

With regards to Tails, Urenco Projects division will manage the currency of the technical assumptions behind the tails disposal cost estimate. The cost estimate will be reviewed each year and at a frequency greater than five years but also less than ten years, the estimate will be re base lined. The re base line exercise will employ recognised industry expert organisations to review the tails disposal functional specification against best available technology and processes of the day.

Other operating companies within the Urenco Group have a requirement to implement a tails deconversion policies at an earlier time than UCL. The Almelo site has already undertaken a limited trial deconversion of UF<sub>6</sub> to U308 in support of its licence application to the transfer of ownership of the deconverted Uranium to the Dutch national repository, COVRA.

The licence for the safe storage of U308 at COVRA has now been granted and Almelo is currently in negotiation with Cogema to undertake first tranche deconversion exercise to fill one storage hall at COVRA, in order to formally demonstrate the route. The knowledge and cost data from these exercises will be fed into the UCL cost estimate and technical assumptions at each review.

## **15. CONSULTATION WITH REGULATORS AND GENERAL PUBLIC / OTHER INTERESTED PARTIES**

Periodic high level meetings are held between UCL and its two main regulators (the Nuclear Installations Inspectorate and the Environment Agency). In addition, UCL keeps both regulators appraised of its plan for major projects through the nominated site inspectors.

With regards to the general public and other interested parties, UCL and BNFL Capenhurst hold a joint Local Liaison Committee. The Capenhurst District Liaison Committee comprises representatives from BNFL Capenhurst, UCL, the local government, the emergency services and the Regulatory Authorities. The committee meets twice a year to discuss matters relating to operations at the Capenhurst site, which are important to the local community.

## **16. CONCLUSION**

The high level strategy for the decommissioning of UCL's Centrifuge Plants and other contaminated facilities has been defined. Recognising the nature of the hazards and operations undertaken at UCL, and based on the decommissioning experience gained to date (during the decommissioning of the K Bay Pilot Centrifuge Plant, the E21 Commercial Centrifuge Plant and the Research and Development Facility), it is anticipated that the decommissioning will be a manageable and relatively straightforward task. Based on past experience, the expectation is that the site will be successfully decommissioned without the need to demolish buildings such that they can be returned to non-nuclear use.

The strategy defines the principles that will be applied to ensure that decommissioning will be achieved with minimum impact on the safety of personnel, the public and the environment.

The strategy also identifies the costs and liabilities for decommissioning based on current activities on the UCL site.

The strategy and cost estimate is reviewed once per year and re base lined periodically (each 5 years). In addition, the cost estimate is verified against actual decommissioning work proceeding within the group.

Finally, an ongoing improvement programme is in place in respect of processes assumed within the cost estimate and in respect of the environmental impact of the processes.

## **APPENDIX 1**

### **UCL Health, Safety and Environmental Policy**

The Company is committed to:

- maintaining a high standard of health and safety;
- minimising the effects of its activities on the public;
- the continuous improvement of its environmental performance with a view to reducing environmental impacts through the economically viable application of best available technology.

The Company will encourage a commitment to good health, safety and environmental practice from its employees and others working on the site.

The Company will comply with all relevant national and international legislation on health, safety and the environment and other pertinent standards and guidelines.

The Company will develop and maintain its health, safety and environmental management system to ensure that its activities are carried out in a safe and environmentally acceptable manner.

The Company will assess the environmental and safety impact before all new activities, products and processes are introduced.

The Company will develop and maintain procedures and measures for the following matters:

- consultation on health, safety and environmental matters with employee representatives;
- provision of information on health, safety and environmental performance to employees, the public and, where appropriate, the regulatory authorities;
- minimising emissions that could occur in the event of an accident;
- providing relevant information to employees and the general public about these procedures;
- co-operation with the public authorities and provision of information to employees and the general public on any accident or incident which may be of concern to them;
- promoting recycling and reviewing energy and water usage so that environmental effects are reduced;

- monitoring the effective implementation of the policy and the environmental objectives and targets and where non-compliance is detected reviewing the health, safety and environmental management system;
- assess the environmental performance of our suppliers and give preference to our key supplies who share our environmental ideology.

The Company's environmental objectives and progress in achieving them will be published annually.