Health and Safety Executive

NUCLEAR DIRECTORATE

GENERIC DESIGN ASSESSMENT – NEW CIVIL REACTOR BUILD

STEP 3 RADIOACTIVE WASTE AND DECOMMISSIONING ASSESSMENT OF THE WESTINGHOUSE AP1000

DIVISION 6 ASSESSMENT REPORT NO. AR 09/023-P

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EXECUTIVE SUMMARY

This report presents the findings of the radioactive waste and decommissioning assessment of Westinghouse's Pre-Construction Safety Report (PCSR) (Ref. 1) undertaken as part of Step 3 of the Health and Safety Executive's (HSE) Generic Design Assessment (GDA) process.

This report provides an overview of the safety case presented in the PCSR and supporting safety documentation; the standards and criteria adopted in the assessment; and an assessment of the claims, arguments and evidence provided within the safety case.

For Step 3 of GDA, HSE's guidance requires me to confirm that Westinghouse has comprehensive plans for dealing with radioactive waste from creation through to disposal on the nuclear power plant. This guidance goes on to say that HSE will undertake an assessment on a sampling basis primarily directed at the system level and by analysis of Westinghouse's supporting arguments. On the topic of radioactive waste and decommissioning this includes consideration of the results of step 2 assessment, which highlighted the need for more information on disposability of the wastes and the through-life storage of wastes and spent fuel.

Westinghouse has set out its safety arguments for radioactive waste and decommissioning in the PCSR and a number of supporting references. These include: details of the source and types of radioactive waste produced; the design and operation of the at-reactor spent fuel pond; details of the Waste Treatment Building, which will house the processing and packaging systems for operational wastes, other than spent fuel; proposals for an ILW storage facility that will provide retrieval, inspection and, if necessary, refurbishment of waste packages; and a number of options for the long-term storage of spent fuel.

Nuclear Directorate's assessment sample included the type of waste produced, which underpins all of the other assessments; and the long-term storage of wastes and spent nuclear fuel, which is important because of the timescales involved.

At the start of the GDA process the level of information on the management of radioactive waste was limited. As we reach the completion of Step 3 the information developed by Westinghouse on the management of radioactive wastes produced by an AP1000 is at a level where I can undertake a meaningful assessment.

In undertaking my Step 3 assessment, I have worked closely with the Environment Agency and Department for Transport to assure myself that Westinghouse has identified all significant waste arisings and discharge routes, and that those wastes can be effectively managed.

In performing my Step 3 assessment of Westinghouse's proposals for Radioactive Waste & Decommissioning I have taken on board feedback from a wide range of stakeholders

During Step 3 Westinghouse provided oral assurance that the radioactive wastes and spent fuel produced by the AP1000 are likely to be suitable for disposal. The disposability assessment prepared by the Nuclear Decommissioning Authority is now complete and has been provided by Westinghouse. In Step 4 Westinghouse will need to show me evidence that the wastes produced by an AP1000 are disposable.

Finally I have commenced my assessment of whether an AP1000 can be safely decommissioned ; many of the features designed to reduce and complexity and reduce operator doses will provide a firm basis for facilitating decommissioning.

During the assessment I have not identified any significant issues, or significant design or safety case changes that could impact on radioactive waste arisings or have a significant negative environmental impact.

LIST OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
BMS	(Nuclear Directorate) Business Management System
CoRWM	Committee on Radioactive Waste Management
DECC	Department for Energy and Climate Change
EA	The Environment Agency
GDA	Generic Design Assessment
GDF	Geological Disposal Facility
HSE	The Health and Safety Executive
IAEA	The International Atomic Energy Agency
ILW	Intermediate Level Waste
LLW	Low Level Waste
ND	The (HSE) Nuclear Directorate
NDA	Nuclear Decommissioning Authority
NRC	United States Nuclear Regulatory Commission
PCER	Pre-construction Environment Report
PCSR	Pre-construction Safety Report
TAG	(Nuclear Directorate) Technical Assessment Guide
TQ	Technical Query
RI	Regulatory Issue
RIA	Regulatory Issue Action
RO	Regulatory Observation
ROA	Regulatory Observation Action
RP	Requesting Party
SAP	Safety Assessment Principle
SSC	System, Structure and Component
WEC	Westinghouse Electric Company LLC
WENRA	The Western European Nuclear Regulators’ Association

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1 INTRODUCTION

1 This report presents the findings of the radioactive waste and decommissioning assessment of the Westinghouse AP1000 Pre-Construction Safety Report (PCSR) (Ref. 1) undertaken as part of Step 3 of the HSE Generic Design Assessment (GDA) process. This assessment has been undertaken in line with the requirements of the Business Management System (BMS) document AST/001 (Ref. 2) and its associated guidance document G/AST/001 (Ref. 3). AST/001 sets down the process of assessment within the Nuclear Directorate (ND) and explains the process associated with sampling of safety case documentation. The Safety Assessment Principles (SAPs) (Ref. 4) have been used as the basis for the assessment of the radioactive waste and spent fuel management and design features to facilitate decommissioning associated with the AP1000 design. The SAPs provide ND inspectors with a framework for making consistent regulatory judgements on radioactive waste and decommissioning aspects of nuclear safety cases on a nuclear power plant or nuclear chemical plant site. Ultimately, the goal of assessment is to reach an independent and informed judgment on the adequacy of a nuclear safety case.

2 By the end of Step 2 there was only limited information from Westinghouse on Radioactive Waste and Decommissioning. Since then Westinghouse has provided further, more detailed information, notably in December 2008 the AP1000 Environment Report was revised and drafts of key sections of Revison 2 have since been supplied. Much of this information is still at a higher level than for other parts of the design. In particular, the submissions on the processes for conditioning of wastes describe the overall process rather than the equipment, but this is broadly consistent with the joint position statement (Ref. 6) issued in June 2009 by the Environment Agency , Department for Transport and ND outlining the level of design required on the waste plants in GDA.

3 There are four steps in the GDA process:

- Step 1: discussion with Requesting Party.
- Step 2: fundamental safety review.
- Step 3: overall design safety review.
- Step 4: assessment for design acceptance.

4 It is not appropriate to consider radioactive waste and decommissioning in isolation from other disciplines: measures which could reduce radioactive waste arisings may be achieved only at the expense of increasing radiation doses to personnel or discharges. Similarly, fuel and coolant chemistry variations may influence radioactive waste arisings. I have therefore maintained close contact with ND colleagues assessing chemistry and radiation protection and have worked particularly closely with the Environment Agency. In addition I have maintained a regular exchange of information with my colleague, who is assessing the EDF and AREVA UK EPR design, to ensure consistency in our approach.

5 The Department for Transport (DfT) regulates the transport of radioactive waste and spent fuel and there are clear synergies between the long-term management of these and the need to be able to transport them safely to a relevant disposal facility. I have included DfT colleagues in discussions and I am keeping them appraised of our work on storage.

6 I have also utilised information obtained from visiting other nuclear sites, relating to the operating experience with the designed radioactive waste systems. Of particular note was the importance attached by operators to the flexibility to reconfigure and update systems over the lifetime of the plant, rather than being tied too tightly to an initial design.

7 To meet the GDA deadlines I have engaged Technical Support Contractors(s) (TSC) to inform my assessment work. This includes a review of practice used in Pressurised

Water Reactors to minimise radiation doses and radioactive waste and the development of guidance on the management of spent fuel for GDA.

8 I visited Westinghouse's offices in Pittsburgh in July 2008 and again in August 2009 to discuss radioactive waste and environmental matters. The first visit in collaboration with the Environment Agency included presentations and a visit to Joseph M Farley Nuclear Plant which included the spent fuel drying and storage process; the second visit was in support of a series of meetings concerning plant chemistry.

9 Stakeholders attending a meeting with ND and the Environment Agency in July 2009 expressed particular concern about the impact of increased burn-up on storage and disposal. It is intended to assess this in more detail in GDA Step 4.

10 The SAPs indicate that there should be comprehensive plans for dealing with radioactive waste from creation through to disposal on the nuclear power plant and that these are considered in safety assessments. Ultimately, the goal of assessment is to reach an independent and informed judgment on the adequacy of a nuclear safety case.

2 NUCLEAR DIRECTORATE'S ASSESSMENT

2.1 Requesting Party's Safety Case

11 On 1 February 2008, the Environment Agency raised Regulatory Issue RI-AP1000-01 on Westinghouse stating that the original submission was lacking in detail with respect to a waste and spent fuel strategy, and setting out the expectation of an Integrated Waste Strategy (IWS). Westinghouse's revised submission, received in January 2009, included:

- AP1000 Environment Report UKP-GW-GL-790 Revision 1.
- AP1000 Pre-Construction Safety Report (PCSR).
- AP1000 Best Available Technology Report UKP-GW-GL-026, Revision 0.
- AP1000 Environment Report UKP-GW-GL-789 Rev. 1.
- A number of supporting reference documents.

12 Radioactive waste arises by virtue of radioactive materials introduced into the reactor (e.g. fuel and associated tramp uranium) and activation of the reactor fabric and coolant chemicals. A primary source of liquid waste (in terms of its activity content) is from expansion of the reactor coolant during start-up and the need to dilute boron during the reactor cycle to compensate for reductions in fuel activity.

13 Westinghouse claims to have limited the use of materials which could give rise to cobalt in the primary circuits, by judicious use of low nickel steels and using Stellite™ only for those applications for which no suitable substitute can be identified. During a visit to Westinghouse in August 2009 Westinghouse explained that it is conducting a review of the dose reduction accruing from Stellite™ replacement and intends to evaluate whether there are further opportunities for Stellite™ reduction.

14 Gaseous wastes are treated to remove hydrogen and filtered to remove any particulate; a carbon bed delay system allows for decay of short-lived gaseous products. Routine discharges would be subject to regulation by the Environment Agency.

15 The AP1000 includes a fuel pond and ancillaries designed to allow the safe receipt of fresh fuel, its transfer into and out of the reactor, management in the pond during reactor shutdown, drying and dispatch to long term dry cask storage. This facility will have a longer operating life than the reactor as it is used to receive fresh fuel before the start of reactor operations and will be used to store spent nuclear fuel from the end of reactor operations prior to transfer to a longer-term on-site storage facility.

16 The Waste Treatment Building will house the processing and packaging systems for operational wastes, other than spent fuel, produced by the reactor. The processing and packaging system will be based on proven and internationally recognised technologies. The waste is processed into standard packages for safe handling. The Radwaste Building includes a buffer store for wastes prior to processing. After processing, ILW will be dispatched to an on-site, interim long-term store and LLW will be dispatched to a disposal facility.

17 The AP1000 uses filtration for both aerial and liquid systems and ion exchange systems to remove radioactive species from the coolant circuits, thus generating waste in the form of used filters and ion exchange resins. Westinghouse's intention is that after treatment liquid wastes will be discharged to the environment, in accordance with the conditions of Authorisations from the Environment Agency. Used filters and spent ion exchange resins will be encapsulated and disposed of as solid waste.

18 Westinghouse proposes to make use of skid-mounted processing systems for some treatment streams so that equipment can be easily updated as it ages or new techniques are introduced.

19 Westinghouse proposes Holtec International's HI-STORM 100U dry fuel storage system for longer term storage of spent fuel: after cooling in the pond, fuel would be retrieved and dried in helium before being transferred into dry storage. Subsequently the fuel would be consigned for disposal into the planned Geological Disposal Facility (GDF). Although Westinghouse expects that operators may wish to follow a different strategy, it has been considered here as the reference design; any change (e.g. construction of additional pond capacity) would have to be assessed afresh, presumably in response to a licence application.

20 It is worth noting that Westinghouse is a designer / vendor and intends to leave some decisions to the potential operator. This means that proposals assessed now may differ from those eventually forwarded for licensing and indeed could differ in some respects between potential operators

21 Westinghouse has produced an analysis of the AP1000 with respect to the use of 'Best Available Technology' (Ref. 9). Although this term derives from environmental legislation the report contains information which supports Westinghouse's As Low As Reasonably Practicable (ALARP) claims from a radioactive waste and decommissioning perspective.

22 Westinghouse has made provision for the addition of zinc (i.e. zinc depleted in ^{64}Zn) acetate, which is claimed to reduce corrosion in the primary circuit as a mechanism for reducing personnel doses by around 30% and intend its use to be a condition of the fuel warranty. Westinghouse's response to TQ-AP1000-145 (Ref. 10) clarifies that depleted zinc (i.e. zinc depleted in ^{64}Zn) will be used.

23 The original submissions presented by Westinghouse did not include a formal strategy for radioactive waste and spent fuel although there were points throughout the documentation giving indications of the broad approach. The ND and the Environment Agency raised Regulatory Observation (Ref. 11) RO-AP1000-34 in June 2009 to request *inter alia* an 'integrated waste strategy', which is expected later in 2009 so hasn't been assessed during Step 3.

2.2 Standards and Criteria

24 There are a number of SAPs specific to waste management and decommissioning. The SAPs on nuclear matter will supplement them because of the diverse nature of the material. Table 1 details the SAPs specific to radioactive waste and decommissioning. I have assessed the Westinghouse safety case on all of this sub-set, recognizing that

Westinghouse will view some of them as more appropriate for potential operators than designers

25 There are also a number of international standards, specifically those produced by the International Atomic Energy Agency (IAEA) and the Western European Nuclear Regulators' Association (WENRA). Table 1 shows the relationship between the SAPs for RW & D and these standards.

26 In 2006 the Government's response to recommendations by CoRWM, established in England and Wales, that deep geological disposal is the preferred route for the long-term management of radioactive waste that is not suitable for near-surface disposal. It also gave the responsibility for delivering the program for a deep geological repository to the Nuclear Decommissioning Authority (NDA).

27 Accordingly, HSE, the Environment Agency and the Scottish Environment Protection Agency (SEPA) have developed a series of joint guidance on the management of higher activity radioactive waste. These specify the production, content, maintenance and review of radioactive waste management cases (RWMCs), and further guidance on how the components of a RWMC may be produced. ND, the Environment Agency and SEPA recognise the Radioactive Waste Management Directorate of NDA (NDA RWMD) as the appropriate body to advise licensees on the packaging and conditioning of radioactive wastes. Such advice is provided through NDA(RWMD)'s Letter of Compliance (LoC) process

28 Licence conditions require the licensee (i.e. the operator) to make arrangements for minimising the rate of production and total quantity of radioactive waste accumulated on the site and to ensure it is adequately contained. A RWMC is a key component in demonstrating that the licensee will be able to comply with these arrangements. It may deal with a single waste stream or several related waste streams, but all radioactive wastes produced by an AP1000 should be covered by a RWMC.

29 The production of radioactive waste should be avoided where possible. The judicious choice of materials; the integrity of the fuel; and operational control all play a part in reducing the potential for the production radioactive waste and in turn are influenced by the control of the coolant chemistry. In addition, some options which may lead to an increase in radioactive waste production may be acceptable because of consequential reduction in dose to plant operators.

2.3 Nuclear Directorate Assessment

30 ND works closely with the Environment Agency on GDA to ensure that the reactor designs minimise the production of radioactive waste and spent fuel. Where waste will be generated, together we require a demonstration that it can be safely and securely managed from the point of generation through to final disposal, and with minimum impact on the environment.

31 The Environment Agency is carrying out its own assessment of the environmental implications of the AP1000 as part of the GDA process. Much of the work leading to ND's assessment has been performed in collaboration with the Environment Agency, indeed, in many cases formal Technical Queries have been raised jointly. The Environment Agency intends to consult publicly on its findings from Generic Design Assessment May / June 2010. The scope of the Environment Agency's assessment is set out in its Process & Information Document (P&ID); and includes assessment of non-radioactive wastes, which are not considered here.

2.3.1 Has Westinghouse Identified All Of The Wastes That a UK AP1000 Will Produce?

32 The AP100 will produce a range of different wastes over the lifecycle. My assessment considers only radioactive waste. Therefore, for my assessment the reactor lifecycle starts with the introduction of radioactive material on to the site and finishes once the site is fully decommissioned and the waste sent for disposal.

33 Low Level Wastes (LLW) are those containing radioactive materials other than those acceptable for disposal with ordinary refuse, but not exceeding 4 GBq / te of alpha or 12 GBq / te beta / gamma activity. Westinghouse has provided a detailed list of anticipated LLW. The derivation of this list was the subject of a presentation in August. While the quantities and radioactive are inevitably estimates, these discussions indicated that the basis for the preparation of the list utilises a range of inputs drawn from operating experience of existing plants. TQ-AP1000-383 (Ref. 10) requests further details to allow further analysis with the Environment Agency.

34 Intermediate Level Wastes (ILW) are those containing radioactive materials other than those acceptable for disposal with ordinary refuse, but not exceeding 4 GBq / te of alpha or 12 GBq / te beta / gamma activityTQ-AP1000-232 (Ref. 10) seeks clarification about the status of a number of items which do not appear to be included in the inventory of ILW streams; these include rod cluster assemblies and control rods. A response is awaited.

35 The way that an AP1000 is operated will affect the radionuclide fingerprint in the different waste types. Westinghouse will set limits on some operational parameters but operators will have discretion within those bounds. Changes in the operating regime will also affect other disciplines. To indicate typical effects of different operating regimes I, together with colleagues, have commissioned Amec to produce a brief report on practices used in Pressurised Water Reactors. The overall aim of the work is to:

- review technologies and practices that will reduce worker doses, public doses and radioactive waste arisings (but not necessarily all three simultaneously);
- identify the pros and cons associated with the technologies and practices;
- identify examples where the technology / practice has been used well;
- if appropriate, identify examples where the technology / practice has not been used well;
- identify whether each technology or practice can be used with other technologies or practices (synergy) or whether it cannot be used with other technologies or practice due to conflicting requirements;
- give a broad estimate of the cost to deploy the technology or practice and whether there may be other costs to incur;
- identify the key information references where HSE can look for more detailed information;
- identify any issues associated with the technology or practice that HSE should be aware of;
- identify questions related to the process;

36 It is important to stress that the output is not intended to rank the technologies and practices: the key focus is to improve HSE's knowledge of the issues that can then be used to challenge Westinghouse during GDA Step 4.

2.3.2 Does Westinghouse Have Suitable Plans For Conditioning Of The Wastes?

37 The SAPS (Ref. 4) indicate that waste should be conditioned into a passively safe form. Whilst Westinghouse has provided some information I have not yet assessed their proposals in any detail. But such aspects as I have sampled (e.g. the proposed proportions of grout / resins) appear consistent with practices at existing UK sites.

38 The use of skid-mounted units provides the flexibility to upgrade the systems as new techniques are developed, or even bring in particular systems to solve specific problems, such as contamination with non-radioactive species. As the units are self-contained there is no overriding incentive from a design perspective to finalise details of the equipment to be provided until late in the programme.

39 Westinghouse intends that ILW should be grouted into drums and boxes compatible with the repository concept. Segregation may allow some wastes containing short-lived radionuclides, classified initially as ILW, to be disposed of as LLW after a period of decay storage. ND has advocated such a strategy for a number of years as it allows better use of disposal routes and has the potential to allow earlier disposal. I am awaiting Westinghouse's case to show that these wastes are disposable, but the proposal is similar to strategies already in use in the UK.

40 Westinghouse proposes dry fuel storage which is widely used in the USA and elsewhere, but has not been used in the UK. However, Westinghouse has not presented proposals for eventually encapsulating fuel into a form suitable for disposal – but at a presentation by the NDA's RWMD it was confirmed that the disposability assessment will be predicated on the use of copper containers. In the absence of any other firm agreement it must at this stage be assumed that any encapsulation will be performed at the reactor site and I have raised TQ-AP1000-329 (Ref. 10) requesting information on how the fuel will be encapsulated. A response is outstanding, but when received it will need to be considered with the 'disposability' case.

41 Westinghouse's proposals for conditioning have not been developed into detailed plant designs, but this is acceptable at this stage of GDA. Westinghouse will need to provide more detailed design at a later stage and demonstrate that it represents best practice at that time.

2.3.3 Are There Any Safety Issues With Westinghouse's Plans For Short Term Storage?

42 In June 2009 HSE published a paper, titled *"Level of Design of Waste Plants for New Build Reactors in the GDA"* (Ref. 5). This paper outlines the amount of detail that regulators expect for the design of waste plants in GDA. For ILW the regulators only require demonstration that storage of ILW is feasible. For spent fuel we require a fully detailed design.

43 LLW is to be disposed of as it arises, although prudently a buffer capacity is to be provided for around two years' arisings, to minimise the effect of any disruptions to the disposal or transport services.

44 There must be adequate arrangements for the storage of ILW waste generated during operation and decommissioning until a disposal route becomes available. The proposed ILW store is intended to accommodate ILW arising from the first 20 years of operation – thereafter, modular additions can be made. This means that, on current expectations the first modules must be capable of lasting for at least 100 years (with or without refurbishment), or the waste must be retrieved and consigned to newer stores throughout the lifetime of the site. The latter is a feasible strategy, particularly since the ability to recover waste during storage will protect against unexpected failure of a store. This will be pursued further in GDA Step 4.

45 The spent fuel pool has been sized to store spent fuel arising from approximately 18 years of reactor operation, with fuel burn-up to a peak of 62GWd / tU (averaging around 50GWd / tU), while maintaining a contingency capacity for offload of a full core load. There is a extensive experience throughout the world in the use of fuel storage pond and similar fuel has been stored for a number of years at Sellafield and Sizewell B.

46 The assessment of the reactor spent fuel storage pond will cover receipt of fresh fuel, transfer into the reactor, transfer out of the reactor, management in the pond during reactor shutdown, storage prior to dispatch to the long term store and dispatch to the store. The assessment will be multi-disciplined involving a number of assessors. To provide a common understanding I have requested that Westinghouse should present its case for spent fuel storage at the reactor to a group of assessors. So the majority of the assessment in this area will take place during Step 4.

2.3.4 Are There Any Safety Issues with Westinghouse's Plans for Long Term Storage?

47 The Nuclear Decommissioning Authority (NDA) uses the following dates for planning purposes for the emplacement of legacy wastes and fuel into a Geological Disposal Facility (GDF):

- ILW from 2040.
- HLW (including spent fuel) from 2075.

48 In practice, disposal of new build waste and fuel may well commence later than this and DECC's programme for the funding of liabilities for new build requires provision for storage for 100 years. So Westinghouse's aim of providing storage arrangements for 100 years represents a reasonable target.

49 Westinghouse proposes to grout ILW and store it in standard packages compatible with a GDF. The disposability assessment is expected to address the safety of long-term storage, but given that the waste forms are comparable with existing ones, it is considered likely that long term safety can be demonstrated.

50 While dry fuel storage has not previously been used in the UK there is experience elsewhere in the world; dry fuel storage is accepted as a mature technology in the USA (Ref. 6). As noted earlier I was able to see a similar process in operation at the Joseph M Farley Nuclear Plant in Alabama (a Westinghouse designed PWR) and discuss the (favourable) operating experience with the plant operators.

51 There is little reported information on the condition of fuel in dry storage, but it is worth noting that the US Nuclear Regulatory Commission (NRC) found (Ref. 7) :

> *"reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license (sic)) of that reactor or combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations".*

52 I have been in preliminary discussions with overseas regulators with a view to helping inform ND about the operating and regulatory experiences and expectations of dry fuel storage.

53 The National Nuclear Laboratory is undertaking a short piece of work to identify those mechanisms that could lead to early failure of the fuel cladding or the fuel assembly during storage. This work includes:

- a definition of 'failure' in the context of this work (i.e. what criteria should be employed to the cladding/assembly for it to be no longer considered safe to handle or transport);
- an identification of likely lifetimes for fuel cladding and the assembly for initial failure and chronic failure;
- identification of those factors that affect the lifetime of the cladding or assembly, supported by scoping calculations to indicate the scale of the effect;
- an initial review of the available literature and research papers to identify any areas of research that could identify other mechanisms that would affect the life of the cladding or assembly.

54 The National Nuclear Laboratory's report will be available during Step 4. I will involve Westinghouse in the development of the report so that they are aware of the issues as the work develops and I am aware of any Westinghouse research that should be considered by the National Nuclear Laboratory. This will inform further work to assess the long-term safety of the storage proposal, which will be assisted by guidance which is being developed by a TSC on the storage of spent PWR fuel.

55 It will be important to be able to predict and monitor the condition of wastes and spent fuel during long-term storage so as to be assured of the integrity of the packages for safe storage, transport and disposal. During GDA Step 4 I expect Westinghouse to provide more information on how this will be achieved through the design lifetime of the plant as well as options for retrieval.

2.3.5 Will An Operator Be Able To Dispose Of The Wastes?

56 TQ-AP1000-140 (Ref. 10) sought confirmation of the claim that LLW could be disposed of in NDA facilities. Westinghouse believes that, with the exception of oils and condensate polishing resins, which would be incinerated, all LLW wastes could meet the acceptance criteria for the LLW disposal and has recently forwarded documentation in support of these claims: although this information has not yet been scrutinised in detail, early indications give confidence that it is likely that all the LLW can be disposed of.

57 The Environment Agency regulates the disposal of radioactive waste throughout England and Wales under the Radioactive Substances Act 1993 and ND regulates its storage on nuclear licensed sites under the Nuclear Installations Act 1965 (as amended). Both organisations continue to work together to satisfy themselves as to the disposability of the wastes to be produced by an AP1000.

58 Both ND and the Environment Agency are committed to ensuring that waste streams are not produced unless there is a clear indication that they can be disposed of. To assist in developing its case, Westinghouse has commissioned a 'disposability assessment' from RWMD which will consider whether the identified ILW and spent fuel streams are likely to meet acceptance for a geological disposal facility. At the time of writing the report is still outstanding, but an early presentation by RWMD on 2 July 2009 indicated that all of the waste streams should be acceptable, albeit fuel will need to be cooled for an as-yet-unspecified period before disposal. This will be the subject of continuing work throughout GDA stage 4.

59 It should further be noted that the wastes identified by Westinghouse are similar to wastes previously identified in the UK Radioactive Waste Inventory (Ref. 8). NDA have used this inventory to underpin their concepts. Therefore I consider it likely that wastes from an AP1000 should be disposable after suitable conditioning.

60 Large items of equipment items which might arise (e.g. steam generators and pressure vessel heads) pose a challenge to existing disposal arrangements in the UK. TQ-

AP1000-381 (Ref. 10) seeks further information about Westinghouse's proposals, but it is noted that internationally methods are being developed to cut up large items to facilitate decommissioning, storage and disposal.

2.3.6 Can A UK AP1000 Be Safely Decommissioned?

61 Westinghouse argues that the reduction in the quantity of concrete, pipework and valves employed in the AP1000 compared to earlier plants will facilitate easier decommissioning. The reduction in the amount of activated cobalt in the primary circuit and improved fuel reliability would be expected to reduce the dose from decommissioning activities. These seem reasonable expectations.

62 During Step 3 a contract was placed for the review of AP1000 documentation on decommissioning. The conclusions of this will be available in Step 4 when I will undertake a fuller analysis of Westinghouse's proposals for decommissioning. In addition, the civil engineering assessment being performed for Step 3 has concluded that the plans are adequate at this stage in respect of civil engineering provision for decommissioning.

3 CONCLUSIONS AND RECOMMENDATIONS

63 Westinghouse has continued to add to and refine the documentation provided for this assessment and the frank and open exchanges in which its staff have engaged with me has been a major factor in facilitating this work.

64 The design and supply of a nuclear reactor normally includes the development of facilities for the short term management of spent nuclear fuel within the reactor building and space for facilities to manage other wastes. It is then the responsibility of the operator to develop the detailed plans for the processing and management of wastes. GDA placed a requirement on Westinghouse to develop these plans and show that they comply with all UK requirements. It should be noted that plans in the UK for disposal of wastes and our radiological classification system are different to other countries.

65 At the start of the GDA process the level of information on the management of radioactive waste was limited. As we reach the completion of Step 3 the information developed by Westinghouse on the management of radioactive wastes produced by an AP1000 is at a level where I can undertake a meaningful assessment.

66 In undertaking my Step 3 assessment, I have worked closely with the Environment Agency and Department for Transport to ensure that all significant waste arisings and discharge routes have been identified by Westinghouse, and that those wastes can be effectively managed. This has been successful as I have been able to share resources and co-ordinate feedback to Westinghouse.

67 An example of the regulators interacting to provide a single set of requirements on Westinghouse can be seen in the paper on the level of design of waste plants in GDA (Ref. 5). This clarifies the minimum position for radioactive waste management so that the output of GDA is meaningful and without exclusions.

68 In performing my Step 3 assessment of Westinghouse's proposals for radioactive waste and decommissioning I have taken on board feedback from a wide range of stakeholders, in particular, concerns expressed about prolonged fuel storage.

69 By the end of Step 3, Westinghouse has identified all of the wastes that an AP1000 will typically produce. I am confident that this is suitable to underpin my assessment.

70 My assessment of Westinghouse’s plans for conditioning of the wastes will continue through Step 4 when I have been supplied with information on the disposability of the wastes.

71 For short-term storage, Westinghouse has to confirm that there are no safety issues with their plans. Short-term storage of spent fuel will be assessed in more detail. For the remaining wastes the arguments made in support of other areas show that short term storage is feasible.

72 Westinghouse has provided detailed arguments for the safety of long term storage. I judge the reports show that safe long-term storage is feasible. In Step 4 I will require further evidence on specific aspects of the storage regime.

73 During Step 3 Westinghouse has provided assurance that the radioactive wastes produced by an AP1000 are likely to be suitable for disposal. The written disposability assessment prepared by the Nuclear Decommissioning Authority is now complete and has been provided to Westinghouse. I will need to see evidence showing that the wastes produced by an AP1000 are disposable.

74 It should be noted that the wastes identified by Westinghouse are similar to wastes previously identified in the UK Radioactive Waste Inventory (Ref. 8). NDA have used this inventory to underpin their concepts. So my interest is how Westinghouse proposes that an operator should safely condition and store the waste in a manner compatible with the conclusions of the NDA disposability assessment.

75 Finally, I have commenced my assessment of whether an AP1000 can be safely decommissioned.

76 In undertaking our Step 3 assessment, we have worked with the Environment Agency to assure ourselves that Westinghouse has identified all significant waste arisings and discharge routes, and that those wastes can be effectively managed. We have not identified any significant issues, or significant design or safety case changes that could impact on radioactive waste arisings or have a significant negative environmental impact.

77 If during our Step 4 detailed assessment we identify an issue that impacts on radioactive waste arisings or other environmental impact, we should notify the Environment Agency. We will do this through our routine joint working arrangements on GDA, and where appropriate in response to the Environment Agency’s consultation process.

4 REFERENCES

1 *AP1000 Pre-construction Safety Report.* UKP-GW-GL-732, Revision 1, Westinghouse Electric Company LLC, March 2009.

2 *ND BMS, Assessment Process*, AST/001. Issue 2, HSE, February 2003.

3 *ND BMS, Guide: Assessment Process*, G/AST/001. Issue 2, HSE, February 2003.

4 *Safety Assessment Principles for Nuclear Facilities.* 2006 Edition, Revision 1, HSE, January 2008.

5 *Level of design of waste plants for new build reactors in the GDA.* HSE, June 2009.

6 http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/dry-cask-storage.html

7 *Waste Confidence Update 10 CFR Part 51.* (Docket ID-2008-0482)

8 *The 2007 UK Radioactive Waste Inventory: Main Report.* Defra/RAS/08.002, NDA/RWMD/004, March 2008

9 *AP1000 Nuclear Power Plant BAT Assessment*. UKP-GW-GL-026, Revision 0, Westinghouse Electric Company LLC, January 2009.

10 *Westinghouse AP1000 - Schedule of Technical Queries Raised during Step 3.* HSE-ND, TRIM Ref. 2009/358248.

11 *Westinghouse AP1000 - Schedule of Regulatory Observations Raised during Step 3.* HSE-ND, TRIM Ref. 2009/358257.

12 *Westinghouse AP1000 - Schedule of Regulatory Issues Raised during Step 3.* HSE-ND, TRIM Ref. 2009/358258.

Table 1

SAPS Relevant to Radioactive Waste & Decommissioning

SAP No.	SAP Title	Assessed Category *	WENRA ** (Ref. 5, 6)	IAEA *** (Ref. 7)
DC.1	Design and operation	S3	D-12, D-13	
DC.2	Decommissioning strategies	S3	D-14 to D-25	
DC.3	Timing of decommissioning	S3		
DC.4	Planning for decommissioning	S3		5.68
DC.5	Passive safety	S3		
DC.6	Records for decommissioning	S3	D-10, D-11	
ENM.1	Strategies for nuclear matter	S3	S-62 to S-65	6.90
ENM.4	Control and accountancy of nuclear mater	S3		6.92
ENM.5	Characterisation and segregation	S3		
ENM.6	Storage in a condition of passive safety	S3	S-19, S21 to S-38	6.91, 6.97, 6.98
ENM.7	Retrieval and inspection of stored nuclear mater	S3	S-35 to S-38	6.91
RW.1	Strategies for radioactive waste	S3		6.90
RW.2	Generation of radioactive waste	S3		
RW.3	Accumulation of radioactive waste	S3		
RW.4	Characterisation and segregation	S3	D-43, D-44	
RW.5	Storage of radioactive waste and passive safety	S3	S-19, S21 to S-38	6.91, 6.92
RW.6	Passive safety timescales	S3	S-20, S-22	
RW.7	Records for management of radioactive waste	S3	S-15 to S-18	

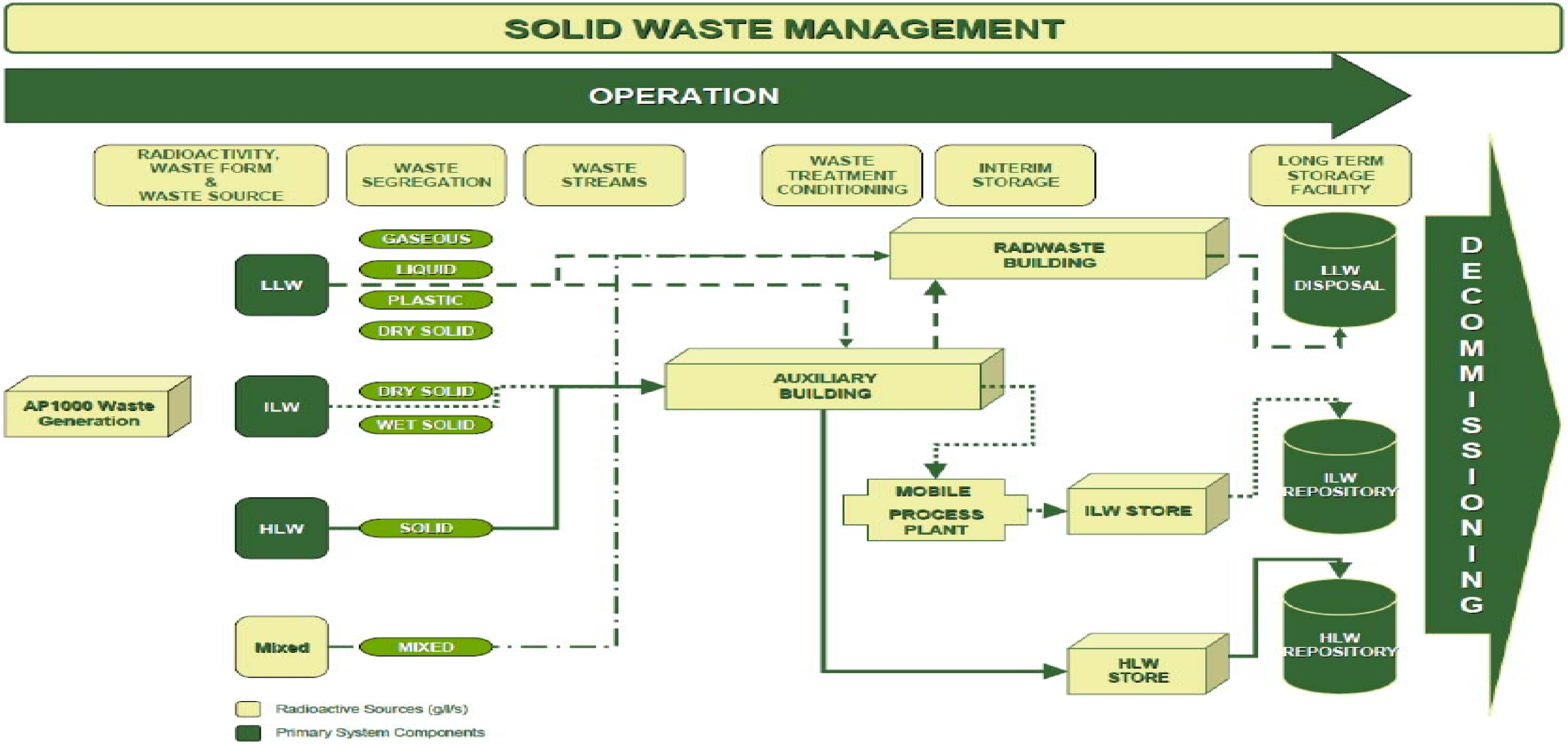
* *S3 = Assessment commences at STEP 3 or 4*

** *The WENRA reference levels are met by the relevant SAPs, but not in a one to one correlation. A number of the Wenra reference levels are relevant to the operation of the facilities, it is not appropriate to address these at this stage*.

*** IAEA NS-R-1 sub paragraphs (7) is for Licence Applicants.

Figure 1 - AP1000 Solid Waste Treatment

(Courtesy of Westinghouse)



Annex 1 – Radioactive Waste and Decommissioning – Status of Regulatory Issues and Observations

RI / RO Identifier	Date Raised	Title	Status	Required timescale (GDA Step 4 / Phase 2)
Regulatory Issues				
RI-AP1000-01	1 Feb 2008	Information required by the Environment Agency for the detailed assessment stage	Closed.	
Regulatory Observations				
RO-AP1000-34	8 June 2009	Integrated Waste Strategy	Open.	Step 4