Generic design assessment

AP1000 nuclear power plant design by Westinghouse Electric Company LLC

Assessment report
Monitoring of radioactive disposals

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Assessment report - monitoring of radioactive disposals

Protective status	This document contains no sensitive nuclear information or commercially confidential information.
Process and Information Document[1]	The following sections of Table 1 in our Process and Information document are relevant to this assessment: 1.5 – show that the best available techniques will be used to minimise the production of waste 2.6 – describe the sampling arrangements, techniques and systems proposed for measuring and assessing discharges and disposals of radioactive discharges.
Radioactive Substances Regulation Environmental Principles[2]	The following principles are relevant to this assessment: RSMDP 13 – Monitoring and Assessment: The best available techniques, consistent with relevant guidance and standards, should be used to monitor and assess radioactive substances, disposals of radioactive wastes and the environment into which they are disposed. ENDP10 – Quantification of Discharges: Facilities should be designed and equipped so that best available techniques are used to quantify the gaseous and liquid radioactive discharges produced by each major source on a site.
Report author	Jane Rowe and Rob Allott

1. Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs, Environment Agency, Jan 2007.

   http://publications.environment-agency.gov.uk/pdf/GEHO0107BLTN-e-e.pdf

2. Regulatory Guidance Series, No RSR 1: Radioactive Substances Regulation - Environmental Principles (REPs), 2010.

   http://publications.environment-agency.gov.uk/pdf/GEHO0709BQSB-e-e.pdf

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1 Summary

1 This report covers the assessment of the sampling arrangements, techniques and systems proposed for measuring and assessing discharges and disposals of radioactive waste for the Westinghouse AP1000 design as required in Table 1 section 2.6 of our process and information document (P&ID) (Environment Agency, 2007). This assessment covers both gaseous and liquid effluents, and solid waste disposals.

2 It is noted that much of the requested information has not been provided as the designs have not yet been completed.

3 We did not conclude that the AP1000 utilises the best available techniques (BAT) to measure and assess radioactive disposals and, therefore our conclusion is subject to one other issue:

a) The monitoring of gaseous, aqueous and solid discharges and disposals of radioactive waste.

2 Introduction

4 We expect the design to use the best available techniques (BAT) to measure and assess discharges of radioactive waste to the environment. This will enable any operational AP1000 to:

a) confirm that discharges are as predicted by the designer;

b) assess compliance with limits;

c) provide good quality data for dose assessments.

5 We set out in our P&ID the requirements for a requesting party to provide information. Section 2.6 of the P&ID requires a description of and supporting reasoning for the sampling arrangements, techniques and systems proposed for measurement and assessment of discharges and disposals of radioactive waste. This included whether these are sufficient and adequate to determine all discharges and disposals from the facility at the levels of detection specified in EU Commission recommendation 2004/2/Euratom (EC, 2004) and showing that they represent the best practicable means for such analyses.

6 In this report we assess the techniques Westinghouse use in the AP1000 to monitor radioactive disposals. Westinghouse submitted its AP1000 nuclear power plant design for generic design assessment (GDA) in August 2007.

7 We found that the submission did not contain the level of information we needed to carry out a detailed assessment but Westinghouse committed to providing further information. In January 2009, Westinghouse provided this additional information; revision 1 of its Environment Report (ER) with supporting documents.

8 Although the information provided was generally much improved it was still not complete in regard to the monitoring of radioactive disposals and hence technical queries (TQ-AP-1000-212 (liquid) and TQ-AP1000-213 (gaseous)) were issued. A revised version of the ER was received in December 2009 (revision 2), and subsequently in April 2010 (revision 3) incorporating TQ responses which is published along with other documents on the Westinghouse website (https://www.ukap1000application.com/ap1000_documentation.aspx).

9 Our findings on the wider environmental impacts and waste management arrangements for the AP1000 reactor may be found in our Consultation Document (Environment Agency, 2010a).

3 Assessment

3.1 Assessment Methodology

10 The basis of our assessment was to:

a) review appropriate sections of the ER and its supporting documents;

b) hold technical meetings with Westinghouse to clarify our understanding of the information presented and explain any concerns we had with that information;

c) raise Regulatory Observations (ROs) and Technical Queries (TQs) where we believed information provided by Westinghouse was insufficient;

d) assess the techniques proposed by Westinghouse for the monitoring of radioactive disposals;

e) decide on any issues to carry forward from GDA.

3.2 Assessment Objectives

11 The assessment considered:

a) The sampling arrangements, techniques and systems proposed for measurement and assessment of the discharges and disposals of radioactive waste.

b) The specific nuclides to be monitored and whether systems are adequate to meet the levels of detection specified in EU Commission recommendation 2004/2/Euratom (EC, 2004).

c) Whether the arrangements represented Best Available Techniques (BAT).

d) How monitoring proposals compared to our M1, M11 and M12 guidance, also a commitment to MCERTS (Monitoring Certification Scheme[1]) was sought (Environment Agency, 2010b, 1999a, 1999b and 2008, respectively).

3.3 Westinghouse documentation

12 We referred to the following documents to produce this report:

Document reference	Title	Version number
UKP-GW-GL-790	UK AP1000 Environment Report	2
UKP-GW-GL-029	AP1000 Generic Design Measurement and Assessment of Discharges.	0

13 We use short references in this report, for example:

a) ER = Environment report;

b) MAD = AP1000 Generic Design Measurement and Assessment of Discharges.

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1 MCERTS is the Environment Agency's Monitoring Certification Scheme. It provides the framework for businesses to meet our quality requirements. If Operators comply with MCERTS we can have confidence in the monitoring of emissions to the environment. You can read about how MCERTS is used to approve instruments, people and laboratories by visiting www.mcerts.net.

3.4 Monitoring of gaseous disposals

14 For the main plant vent, monitoring will be undertaken for particulates, iodine and noble gases, using continuous sampling and an isokinetic sampling nozzle. Grab samples can also be taken for laboratory analysis.

15 Key radionuclides for the monitoring of aerial discharges were identified as tritium, carbon-14, krypton-85, iodine-131 and other particulate (e.g. cobalt-60 or caesium-137). Originally it was stated that tritium and carbon-14 monitoring was not included in the design of the continuous monitoring system. This was taken up in the technical query (TQ) and Westinghouse responded and updated the ER accordingly - see below.

16 Proposed limits of detection will not meet those required by EU Commission Recommendation 2004/2/Euratom (EC, 2004) for iodine-131, strontium-90 and caesium-137 (MAD Table 3).

17 Westinghouse carried out a review against Technical Guidance Note M11 (Environment Agency, 1999a) requirements with broad consistency being claimed, with reference to American National Standard ANSI N13.1-1969 (ANSI, 1969) although evidence was not provided. Westinghouse stated that some of the differences were to be addressed at future stages of the design and authorisation process.

18 No formal BAT assessment was undertaken when considering the monitoring options. Westinghouse stated the process is underpinned by conforming to US standards and the use of equipment utilised in the US. MAD Table 11 compares proposed equipment with UK practice – there are differences in analytical techniques.

19 A technical query was issued to confirm the location and facilities for the monitoring, sampling and flow measurement of gaseous effluent discharges from the AP1000. Also, at this early design stage, to confirm that the design includes provision for adequate facilities to allow for monitoring to our required standards. As our Nuclear Sector Plan (NSP) (Environment Agency, 2009) intends to extend the application of the MCERTS Monitoring Certification Scheme to radioactive discharges in the future, we also wished to confirm that the AP1000 design will be able to comply with these future requirements.

20 The design of the stack monitoring system is still being developed and equipment specifications have not been completed. When the instrument to be used for flow rate measurement has been specified, Westinghouse states in ER section 6.2.1.1 that it will review the MCERTS register to see if a suitable instrument is available. Information on monitoring and flow measurement points and upstream and downstream disturbances and the location of filtration have not yet been determined.

21 The updated ER section 6.2.1.1 indicates that a bubbler system for sampling of tritium and carbon-14 was being incorporated into the design of the main stack monitoring system.

22 There are requirements for the area surrounding the monitoring locations to provide safe access and sufficient room for the Westinghouse monitoring requirements. The design of this area is still being developed, but Westinghouse states in ER section 6.2.1.1 that industry codes and standards along with Technical Guidance Note M1 (Environment Agency, 2010b) will be considered.

23 Westinghouse states in ER section 6.2.1.2 that the AP1000 will have on site laboratory facilities, but that specification of equipment and implementation of processes necessary to gain accreditation to ISO 17025 (BSi, 2005) is operator specific.

3.5 Other issues for monitoring of gaseous disposals

24 Information is still required on the location of monitoring and flow measurement points. Westinghouse recognises that the sampling point needs to be where flow is well mixed and has a relatively constant velocity profile, however, no information has been provided on how this will be achieved / proven. Westinghouse will need to establish uniform flow and gases homogenous at the chosen sample point. When quoting velocities Westinghouse states they assume uniform flow, but no evidence was provided on the measures being taken to ensure this. This information will be required and assessed in the site-specific permitting phase.

25 No information was provided on any physical and chemical properties of the inputs to the stack which could affect monitoring requirements. This information will be required and assessed in the site-specific permitting phase.

26 Only one sample point is being included in the design of the sampling system, with the exact design not having been determined. Therefore our requirement for additional connections or probes, to allow for replacement equipment, if there is a failure during operational periods, and independent sampling, is not being met. Westinghouse states that facilities in the preliminary design allow for grab samples to be taken during system failures or for independent samples to be taken. The availability of a working area for regulator requirements was stated by Westinghouse to need a review. This information will be required and assessed in the site-specific permitting phase.

27 A long vertical drop of 18 to 24 m is being proposed between the monitoring point and sample system (located in the uppermost floor of the auxiliary building) – although no detailed design is available. This is stated by Westinghouse to be balancing control of the environment of the sampling equipment and long pipe run. However, since the requirements of TGN M11 (Environment Agency, 1999a) call for the length of pipe work between probe and sample collector to be as short as possible, this matter will need to be addressed in the site-specific permitting phase.

28 The detectors for monitoring noble gases, iodines and radioactivity associated with particulate matter (including cobalt-60) have not been determined, and no information on what Westinghouse intends to require in terms of precision, bias, retention/capture characteristics has been provided. This information will be required and assessed in the site-specific permitting phase.

3.6 Monitoring of liquid disposals

29 Three discharge streams for liquid radioactive effluents were identified - the liquid radwaste, waste water and service water systems, the latter two could contain low levels of radionuclides and are minor discharge routes under normal conditions. All three streams are released through the same pipeline. For the liquid radwaste, continuous online monitoring is included for caesium-137 in the discharge pipe. Also samples from the discharge tank are collected and analysed before discharge – tanks are mixed thoroughly before sampling. Similar arrangements are proposed for the minor discharge streams. Key nuclides for monitoring are given as tritium and a fission product e.g. caesium-137, but the intent is only to monitor for caesium-137; its limit of detection for this radionuclide meets the EU Commission Recommendation 2004/2/Euratom (EC, 2004) required value. Westinghouse stated it could determine the other EU Commission recommended radionuclides that is tritium, cobalt-60 and strontium-90 by grab samples if required.

30 A comparison between TGN M12 (Environment Agency, 1999b) and the proposed monitoring arrangements was carried out by Westinghouse. Westinghouse stated its arrangements broadly conform with M12 objectives and principles, with some of the differences expected to be addressed at future stages of the design and licensing process.

31 No formal BAT assessment was undertaken when considering the monitoring options. Westinghouse stated the process is underpinned by conforming to US standards and the use of equipment utilised in the US. MAD Table 12 compares proposed equipment with UK practice – there are differences in analytical techniques.

32 A technical query was issued to confirm the location and facilities for the monitoring, sampling and flow measurement of liquid effluent discharges from the AP1000. Our Nuclear Sector Plan (Environment Agency, 2009) intends to extend the application of the MCERTS monitoring scheme to radioactive discharges in the future. Westinghouse states in the updated ER section 6.2.1.2 that the instrument for flow rate measurement has not been specified, but when it has, Westinghouse would look for a suitable instrument on the register of MCERTS certified equipment.

33 Westinghouse has also indicated in ER section 6.2.1.2 that the design will be able to accommodate both grab sampling as well as proportional sampling to obtain a representative sample (including provision for separate proportional samplers that can be secured to provide independent measurement) on the discharge lines – proportional sampling will be required.

34 There are requirements for sampling and monitoring equipment to be protected from the weather and interference by unauthorised personnel and for analysis to achieve ISO17025 (BSi, 2005) and MCERTS accreditation. Westinghouse states in ER section 6.2.1.2 that all sampling and monitoring equipment will be housed in weather shielded buildings and will be located in areas where access is controlled. Westinghouse also states there will be an on site laboratory with the capability to be accredited by the United Kingdom Accreditation Service (UKAS) to ISO17025, but it was noted these would be operator responsibilities.

3.7 Other issues for monitoring of liquid disposals

35 Prior to tank discharge, grab samples are taken – Westinghouse states that pump suction is taken from the bottom of the tank and returned as quickly as possible to the top minimising the time needed for mixing. Westinghouse states this is to ensure that the tank is fully mixed and that representative samples are obtained. Evidence that the mixing is sufficient to ensure representative sampling will be required in the site-specific permitting phase.

36 Information was not provided on whether the radiation monitor being put in the common discharge line is going to be located above or below the point at which the cooling water return of the circulating water system (CWS) is mixed in.

37 For the monitors on the discharge lines, no specification for the precision, bias and availability / reliability has been provided. This information will be required and assessed in the site-specific permitting phase.

38 The method for determining how the alarm threshold will be set for the monitors on the discharge lines has also not been determined. This information will be required and assessed in the site-specific permitting phase.

39 The instrument for flow rate measurement has not been specified – no information was provided on the minimum specification for accuracy and availability. This information will be required and assessed in the site-specific permitting phase.

3.8 Monitoring of solid waste disposals

40 Westinghouse has provided some limited information on the monitoring of solid waste disposals, which appears in line with current practice. More information is required about how Westinghouse intend to undertake the initial detailed characterisation on each waste stream to determine the complete waste fingerprint. Furthermore, information is required as to how clearance monitoring will be undertaken to ensure

that items believed to be clean are, thus ensuring radioactive waste is not inadvertently released to the environment.

3.9 Compliance with our REPs

41 Our radioactive substances regulation environmental principles (REPs) (Environment Agency, 2010c) were considered in our assessment of Westinghouse's monitoring of radioactive disposals (see above). The table below summarises the position in regards to those REPs considering information from the Westinghouse submission:

REP number	REP title	Information in submission
RSMDP13	Monitoring and assessment	No formal BAT assessment was undertaken when considering the monitoring options. Westinghouse's stated process is underpinned by conforming to US standards and the use of equipment utilised in the US.
ENDP10	Quantification of discharges	Westinghouse stated there will be an on site laboratory with the capability to be UKAS accredited to ISO17025, but it was noted that these would be operator responsibilities.

4 Public comments

42 No relevant public comments were received on this subject during our detailed assessment stage.

5 Conclusion

43 Section 2.6 of the P&ID requested a description of and supporting reasoning for the sampling arrangements, techniques and systems proposed for measurement and assessment of discharges and disposals of radioactive waste.

44 The information provided by Westinghouse on the AP1000 design for the determination of both gaseous and aqueous discharges has been assessed against the requirements of Technical Guidance Notes M1, M11 and M12 (Environment Agency, 2010b, 1999a, and 1999b, respectively) and other best practice for monitoring (e.g. Environment Agency, 2008).

45 The process for nuclear new build can be divided into early design stage, late design stage, construction / commissioning and operation and it has become apparent from the information provided that many of the details requested will only be available at a later stage.

46 The conclusions from this report therefore focus on those matters that need to be incorporated in the early design stage to avoid costly retrospective correction.

47 As the process moves into late design and construction, more information will be required on the general monitoring facilities, the samplers / instruments used and measures taken to obtain a representative sample. Then, moving into commissioning and operations, information will be required on analysis, maintenance, management arrangements and quality assurance.

48 We have concluded that for the monitoring of gaseous disposals:

a) Westinghouse has not demonstrated BAT for the monitoring of gaseous disposals. This matter needs to be closed-out by submission of a BAT assessment at the site-specific permitting phase.

b) The sampling of gaseous disposals being proposed by Westinghouse is inappropriate because only having a single sampling point does not allow for independent sampling. This matter needs to be closed-out by submission of appropriate evidence at the site-specific permitting phase.

c) Westinghouse has provided insufficient information on the location of the gaseous monitoring and flow measurement points and evidence has not been provided to back up statements about how representative samples would be achieved. Therefore, we cannot assess the appropriateness of monitoring of gaseous disposals at this stage. This matter needs to be closed-out by submission of appropriate evidence at the site-specific permitting phase.

d) Westinghouse has provided insufficient information on the sampling lines for gaseous monitoring. The information provided is pointing to them being too long as they descend into the stack. This matter needs to be closed-out by submission of appropriate evidence at the site-specific permitting phase.

49 We have concluded that for the monitoring of liquid disposals:

a) Westinghouse has not demonstrated BAT for the monitoring of liquid disposals. This matter needs to be closed-out by submission of a BAT assessment at the site-specific permitting phase.

50 We did not conclude that the AP1000 utilises the best available techniques to measure and assess radioactive disposals and, therefore our conclusion is subject to one other issue:

a) The monitoring of gaseous, aqueous and solid discharges and disposals of radioactive waste.

References

(ANSI, 1969) ANSI N13.1-1969: Guide to sampling airborne radioactive materials in nuclear facilities, American National Standards Institute, February 1969.

(BSi, 2005) General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)

(EC, 2004) Commission Recommendation of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation *(notified under document number C(2003) 4832)*
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Abbreviations

ANSI	American National Standards Institute
AP1000™	AP1000 is trademark of Westinghouse Electric Company LLC
BAT	Best available techniques
CWS	Circulating water system
ER	UK AP1000 environment report
ERs*.*	Environment report section reference e.g. 3.2.2.2
GDA	Generic design assessment
MAD	AP1000 generic design measurement and assessment of discharges report
MCERTS	Monitoring Certification Scheme
P&ID	Process and information document
REPs	Radioactive substances regulation environmental principles
RO	Regulatory observation
TQ	Technical query
UKAS	The United Kingdom Accreditation Service
WEC	Westinghouse Electric Company LLC

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