

Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-RC-02
Primary Sampling Systems

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Reactor Chemistry	Mechanical Engineering / Radiation Protection / Human Factors / Radwaste / Environment Agency	2	0

GDA ISSUE:	Demonstrate that the sampling arrangements for the primary circuit and connected auxiliary systems of the AP1000® plant are adequate to support safe operation of the plant.
ACTION: GI-AP1000-RC-02.A1	<p>Westinghouse to provide a detailed schedule of sampling required to support operation of the AP1000 plant. This schedule should include consideration of all modes of operation and should consider:</p> <ul style="list-style-type: none"> • Parameters to be measured from which location and the frequency of sampling. • The schedule should be clearly linked back to the safety case. • Where the sample is expected to be collected (i.e. using the Grab Sample Panel (GSP), radiochemical laboratory or local provisions). • Primary circuit and auxiliaries, including but not limited to the Spent Fuel Pool and Waste Liquid System (WLS). <p>The details should be specific to the AP1000 plant and any differences in plant design; reference to industry guidelines is not a sufficient response in itself. With agreement from the Regulator this action may be completed by alternative means.</p>
ACTION: GI-AP1000-RC-02.A2	<p>Westinghouse to provide a justification and evidence that the primary sampling systems (PSS) in the AP1000 plant will support the sampling schedule delivered under A1. The response by Westinghouse should consider:</p> <ul style="list-style-type: none"> • Specific features of the AP1000 design, such as the location of cooling provisions and the maintenance of high pressure lines. • The effect of recent design changes on system performance should be considered, for example the reduction in line diameter. • Specific consideration should be given to

	<p>representative sampling of zinc, corrosion products and hydrogen.</p> <ul style="list-style-type: none"> • A justification should be given to which sample lines are or are not included in the PSS, specifically why backup cooling systems are not sampled through the PSS and why the design of the AP1000 plant does not include an inlet sample from the Chemical Volume control System (CVS). • Justification and evidence should be given on the use of a GSP, as opposed to a ventilated enclosure (as expected in the SAPs ECV 1 - ECV1 – 10 and associated paragraphs), and sampling provisions outside of the GSP (i.e. as currently for some systems and not others). • Justification should be provided for not including a boron meter as a means of continuously monitoring the coolant boron concentration now that a design change to flowing samples has been included. • The impact of the design change on the served and dependant systems should be clearly reviewed and documented (for example, the impact of increased PSS flow on the WLS input or CVS make-up requirements). • Evidence should be provided to demonstrate that waste generation of the system is within the safety case and that the design has sufficient redundancy to accommodate operational transients. <p>With agreement from the Regulator this action may be completed by alternative means.</p>
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RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE

Technical Queries	TQ- AP1000 -533 TQ- AP1000 -535 to TQ- AP1000 -541
Regulatory Observations	RO- AP1000 -55.A8
Other Documentation	<p>Step 4 – Reactor Chemistry Assessment of the Westinghouse AP1000 - AR 11/008</p> <p>SAPs - ENM4, ENM7, EMC24, ECV 1 – ECV 10</p> <p>T/AST/023 - Control of Processes Involving Nuclear Matter</p> <p>SSG-13 - IAEA Safety Standard Chemistry Programme for Water Cooled Nuclear Power Plants</p>

Scope of work:

Westinghouse will evaluate the sampling arrangements for the primary circuit and connected auxiliary systems of the **AP1000** plant to demonstrate they are adequate to support safe operation of the plant or to provide design alternatives. This will include a clear and detailed

definition of all sampling requirements including frequencies and locations of sampling for all plant modes of operation. Based on these sampling requirements Westinghouse will provide justification and technical evidence that the **AP1000** Primary Sampling System (PSS) is adequate to support safe operation of the plant or provide design alternatives or modifications. Existing relevant good practice will be reviewed and taken into consideration.

Description of work:

The activities that will be undertaken to resolve GI-**AP1000**-RC-02 will be divided into two phases:

1. To address action GI-**AP1000**-RC-02.A1, Westinghouse will create a sample schedule that will be documented in **UKP-GW-GL-091**, “**AP1000** Sample Schedule” which will provide the **AP1000** sampling requirements for the primary system and its auxiliaries to support safe operation of the **AP1000** plant in all operating modes. This definition of the **AP1000** sampling requirements is independent of the detailed aspects of the sampling system used to obtain the samples.
2. To address action GI-**AP1000**-RC-02.A2, Westinghouse will conduct an evaluation of the current **AP1000** PSS against the sampling requirements defined in the **AP1000** Sample Schedule, relevant good practice and operational experience. This evaluation will include justification for samples included within the PSS and for the samples from other primary auxiliary systems that are sampled via other means. This will be documented in a UK specific document, “Evaluation of the **AP1000** Primary Sampling Arrangements”. The purpose of this evaluation is to either confirm ONR concerns / identify design shortfalls and potential areas of enhancement or to generate adequate evidence to demonstrate that the current **AP1000** PSS design meets its operating requirements and that sampling of other primary auxiliary systems can be safely and adequately sampled. This will be a holistic review including system design requirements and goals, safety functional requirements, capability of the system, reliability of the system, representativeness of the samples and waste generation. An ALARP assessment will be performed considering design alternatives to address any design shortfalls and potential desired enhancements identified.

Action GI-AP1000-RC-02.A1: Establishment of the AP1000 Primary Sampling System Requirements in UKP-GW-GL-091

It is the responsibility of the utility to develop their own plant specific radiochemistry program which would include a detailed sample schedule indicating the sample frequencies for the various chemistry parameters. However, to address GI-**AP1000**-RC-02.A1 and establish the operating requirements of the sampling features to support the operation of the plant, Westinghouse will develop an example of a detailed sampling schedule required to support the operation of the **AP1000** plant. The sampling schedule will include the following aspects.

- This sampling schedule will be based on International non-**AP1000** plant specific sources such as the Electric Power Research Institute primary chemistry guidelines as well as on **AP1000** plant specific sources such as the **AP1000** chemistry manual, the **AP1000** Technical Specifications and the Westinghouse Supplement to

EPRI PWR Primary Water Chemistry Guidelines Rev. 6 for the **AP1000** Standard Plant. There is a linkage between this task and the chemistry aspects of GI-**AP1000**-CC-01, Limits and Conditions. The content of the two tasks will need to be consistent.

- The sampling schedule will address the primary system and its auxiliaries including but not limited to the RCS, CVS, SFS, RNS, PXS, WGS and WLS.
- Normal operation (**AP1000** Technical Specification Modes 1 & 2), startup (**AP1000** Technical Specification Modes 3 & 4) and cold shutdown (**AP1000** Technical Specification Modes 5 & 6) will be addressed in the sampling schedule.
- Transient sampling requirements other than startup and shutdown.
- A detailed description of the **AP1000** sample frequency for each of the plant modes will be provided by identifying which samples are taken in each mode, which chemistry parameters will be analyzed in each sample, and what the chemistry parameter frequencies are for each sample will be provided.
- Any necessary local sampling requirements will be identified, as well as the locations where these samples will be taken.

Action GI-AP1000-RC-02.A2: Evaluation of the AP1000 Sampling Arrangements for the Primary System and its Auxiliaries in a UK Specific Document

This new document will evaluate the capability of the **AP1000** primary sampling system as presented in the GDA design reference point and other primary sampling design features (local sampling of auxiliary systems) to fulfil their role in support of **AP1000** plant operation. This document will include the following:

1. An overview of the primary sampling system general design requirements and design goals and reference to the appropriate detailed evidentiary documentation. (Westinghouse documentation, operational experience, relevant good practice, etc.)
2. A description and discussion of the **AP1000** PSS including an overview of the design identifying specific features such as the location of all sample points (what is sampled through the PSS and what is not and the relevant justification), the location of the sample coolers, transitions from high pressure to low pressure and the grab sample panel. The discussion will include operator safety aspects during sampling including estimated worker doses.

A justification will be provided to which sample lines are or are not included in the PSS, specifically why the SFS, BDS, RNS and IRWST are not sampled through the PSS, why the design of the **AP1000** plant does not include a CVS inlet sample and other potential deficiencies identified in the Step 4 report. Also, a justification of the grab sample panel versus a ventilated enclosure will be compared and included.

3. A general description of how each sample is collected including the sample collection times as well as the necessary purge frequencies and times. The total time spent on sampling activities will be calculated by using the sample collection time, purge time and the time for the operator to manipulate the valves for sample collection. The total time spent on sampling activities will be compared to the

capability of the system (required purge and sample times versus required sampling intervals). This evaluation will either demonstrate that the current **AP1000** PSS is capable to support the detailed sampling schedule or will identify current **AP1000** PSS system capability shortfalls and potential areas of enhancements.

4. A discussion and evaluation of the impact of the **AP1000** PSS and the required sampling activities on other **AP1000** systems. This will include, but not necessarily be limited to, an evaluation of the CVS make-up requirements and liquid and gaseous waste capacity requirements for waste generated during sampling operations in the various plant modes.
5. An evaluation of the reliability and operability of the **AP1000** PSS system design as presented in the GDA design reference point based on operating experience and review of the Failure Modes and Effects Analysis (FMEA). The result will be to either demonstrate the adequacy of the design or to identify any design shortfalls or potential areas for enhancement. More precisely, the design adequacy and reliability of the major components of the system (manifold, valves, grab sample panel, etc) will be reviewed. Based on the results of the FMEA, the importance of each major component for the PSS system to support safe operation will be discussed. Additionally, specific ONR concerns related to system reliability and accessibility will be discussed.
6. An evaluation of the **AP1000** primary sampling system's ability to provide representative samples for zinc, corrosion products and dissolved hydrogen will be performed either to demonstrate the adequacy of the design or to identify any design shortfall or potential areas of enhancement. It will describe the purging operations of the **AP1000** PSS system design as presented in the GDA design reference point to support representative sampling and review the effects that line diameter and system faults (a leaking valve, cross contamination, etc.) would have on a sample. The evaluation will also justify the ability of the primary sampling system design to effectively sample for suspended solids as well as evaluating the need for continuous, on-line boron sampling and justification for sufficient CVS sampling penetrations.
7. A review of relevant good practice (including operating PWR sampling systems worldwide) will be performed and the above mentioned aspects will be compared and contrasted with relevant good practice.
8. An ALARP assessment of the above aspects of the **AP1000** PSS design. This may be part of the above mention document or a standalone document. The ALARP assessment will include:
 - A summary of ONR concerns, design shortfalls, and potential areas of enhancements identified as part of UKP-GW-GL-091 and the UK specific document described above.
 - For each of those topics, it will identify alternative designs.
 - It will then assess the impact of the alternative design in terms of plant design, worker dose exposure, primary chemistry, etc.
 - Conclusions will be drawn upon the results. It will either justify that the current primary sampling system design is ALARP or ALARP design changes will be

identified.

9. The conclusions of the ALARP assessment will be reviewed by an internal independent review team. The ALARP design changes identified will be incorporated per the Westinghouse design change process as appropriate. These potential design changes are not specifically included in this resolution plan programme as they are yet to be identified and; hence, the scope is unknown.

Schedule/ programme milestones:

Because all Resolution Plan start dates are subject to future contract placements, dates are presently unidentified; therefore schedule dates have been anonymised for consistency. Actual dates will be inserted when contracts are placed.

ID	Task Name	Duration	3rd Quarter			4th Quarter			1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
			M-1	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17
1	Progress and Technical Review meeting	313 days																		
2	Meet with ONR accessors as needed	313 days																		
3	Issue Resolution Plan	283 days																		
4	RC.02 Primary Sampling System	283 days																		
5	Phase 1 - Development of AP1000 Primary Sampling Requirements for the Primary System and Auxiliaries	139 days																		
6	Sample Schedule UKP-GW-GL-091	139 days																		
7	Draft UKP-GW-GL-091, Review and Verified by Qualified Personel, WEC Approval	59 days																		
13	ONR Review of submital	30 days																		
14	WEC support of TQs	50 days																		
15	Phase 2-Evaluation and Justification of AP1000 Primary Sampling Arrangements and ALARP Assessments	194 days																		
16	Evaluation of AP1000 Primary Sampling Arrangements	159 days																		
17	Draft Evaluation, Review and Verified by Qualified Personel, WEC Approval	79 days																		
23	ONR Review of submital	30 days																		
24	WEC support of TQs	50 days																		
25	DCP Process-As Required	85 days																		
26	Develop Draft DCP	20 days																		
27	Review and Approval of DCP per WEC Procedure NSNP 3.4.1	65 days																		
34	Confirmation of Solution for RC.02	0 days																		
35	Preparation of Safety Submission Documentation	40 days																		
41	Regulator to confirm response to action	20 days																		
42	Response received from ONR	0 days																		

Date: Fri 7/15/11

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

Methodology:

Westinghouse will address this GDA issue in two phases. In the first phase, Westinghouse will provide the **AP1000** sampling requirements for the primary system and its auxiliaries. This will be done by establishing representative primary sampling operating requirements for all plant operational modes that allow for safe, reliable operation of the **AP1000** plant. The **AP1000** sampling requirements are independent of the system(s) performing the sampling.

In phase two, Westinghouse will demonstrate that the current **AP1000** PSS design meets its operating requirements in terms of capability of the system, reliability of the system, safe operation and representativeness of the sample or to confirm ONR concerns / identify design shortfalls and potential areas of enhancement or generate adequate evidence. This will be a holistic evaluation and include a review of existing relevant good practice. Design alternatives will be considered and an ALARP demonstration will be performed to either justify that the current primary sampling system design is ALARP or to identify ALARP design changes. ALARP design changes identified will be incorporated per the Westinghouse design change process as appropriate.

Justification of adequacy:

The activities proposed to resolve GI-**AP1000**-RC-02 will provide an evaluation of the primary sampling system to either demonstrate its adequacy or to identify design shortfalls and potential areas of enhancement. The focus areas for evaluation are the capability of the system, reliability of the system, safe operation, representativeness of the sample and comparison with relevant good practice. Design alternatives will be considered to address those shortfalls and potential areas of enhancement. The documents described above will provide evidence in the form of calculations, design evaluations and ALARP assessments to either justify the design of the **AP1000** primary sampling system, or to propose an ALARP design alternative. ALARP design changes identified will be incorporated per the Westinghouse design change process as appropriate.

Impact assessment:

The following documents are anticipated to be effected:

- PCSR – Chapter 21
- Environmental Report as appropriate
- Master Submission List
- Roadmap
- Other design documents as appropriate based on the outcome of the work to resolve this GDA issue