6A Regulatory Guide 1.52, Section C, Compliance Assessment

This Appendix provides the compliance status of the ABWR SGTS design with each of the regulatory positions specified under Section C of Regulatory Guide 1.52, and the revision cited in Table 1.8-20. Following each provision of Regulatory Guide 1.52 is an evaluation of the ABWR compliance with that position. If the ABWR deviates from the Regulatory Guide 1.52 position, justification is provided. Note that the similarly numbered sections from the revisions cited in Table 1.8-21 for ANSI N509 and N510 are used for ABWR SGTS design except as otherwise noted; Regulatory Guide 1.52 references older revisions (1976) of these standards. Compliance as described in the remainder of this response is measured against the applicable section of the standards referenced in Table 1.8-21.

In addition, the term “demister,” used in Regulatory Guide 1.52, is a trademark of Otto H. York Co., Inc. of Parsippany, New Jersey. The ABWR SGTS design includes provision for the use of moisture separators.

ABWR Compliance with Regulatory Guide 1.52, Revision 2, Section C

(1) Environmental Design Criteria

(a) “The design of an engineered safety feature atmosphere cleanup system should be based on the maximum pressure differential, radiation dose rate, relative humidity, maximum and minimum temperature, and other conditions resulting from the postulated DBA and on the duration of such conditions.”

The design is in compliance with this position.

(b) “The design of each ESF system should be based on the radiation dose to essential services in the vicinity of the adsorber section, integrated over the 30-day period following the postulated DBA. The radiation source term should be consistent with the assumptions found in Regulatory Guides 1.3, 1.4 and 1.25. Other engineered safety features, including pertinent components of essential services such as power, air, and control cables, should be adequately shielded from the ESF atmosphere cleanup systems.”

The design is in compliance with this position. Table 3I.3-20 provides the radiation environmental conditions inside secondary containment for plant abnormal and accident conditions. Note that integrated doses for *six* months, not 30 days, are provided in Table 3I.3-20.

(c) “The design of each adsorber should be based on the concentration and relative abundance of the iodine species (elemental, particulate, and organic), which should be consistent with the assumptions found in Regulatory Guides 1.3, 1.4 and 1.25.”

The design is in compliance with this position. A revised Table 6.5-2 is provided.

(d) “The operation of any ESF atmosphere cleanup system should not deleteriously affect the operation of other engineered safety features such as a containment spray system, nor should the operation of other engineered safety features such as a containment spray system deleteriously affect the operation of any ESF atmosphere cleanup system.”

The design is in compliance with this position.

(e) “Components of systems connected to compartments that are unheated during a postulated accident should be designed for post-accident effects of both the lowest and highest predicted temperatures.”

The design is in compliance with this position.

(2) System Design Criteria

(a) “ESF atmosphere cleanup systems designed and installed for the purpose of mitigating accident doses should be redundant. The systems should consist of the following sequential components: (1) demisters, (2) prefilters (demisters may serve this function), (3) HEPA filters before the adsorbers, (4) iodine adsorbers (impregnated activated carbon or equivalent adsorbent such as metal zeolites), (5) HEPA filters after the adsorbers, (6) ducts and valves, (7) fans, and (8) related instrumentation. Heaters or cooling coils used in conjunction with heaters should be used when the humidity is to be controlled before filtration.”

The design is in compliance with this position.

(b) “The redundant ESF atmosphere cleanup systems should be physically separated so that damage to one system does not also cause damage to the second system. The generation of missiles from high-pressure equipment rupture, rotating machinery failure, or natural phenomena should be considered in the design for separation and protection.”

The design is in compliance with this position.

(c) “All components of an engineered-safety-feature atmosphere cleanup system should be designated as Seismic Category I (see Regulatory Guide 1.29) if failure of a component would lead to the release of significant quantities of fission products to the working or outdoor environments.”

The design is in compliance with this position.

(d) “If the ESF atmosphere cleanup system is subject to pressure surges resulting from the postulated accident, the system should be protected from such surges. Each component should be protected with such devices as pressure relief

valves so that the overall system will perform its intended function during and after the passage of the pressure surge."

The design is in compliance with this position. The ABWR SGTS is not subject to "pressure surges" from the postulated accident sufficient to cause damage to the filter train. Secondary containment pressure does increase slightly as part of the post-LOCA heatup process.

(e) "In the mechanical design of the ESF system, the high radiation levels that may be associated with buildup of radioactive materials on the ESF system components should be given particular consideration. ESF system construction materials should effectively perform their intended function under the postulated radiation levels. The effects of radiation should be considered not only for the demisters, heaters, HEPA filters, adsorbers, and fans, but also for any electrical insulation, controls, joining compounds, dampers, gaskets, and other organic-containing materials that are necessary for operating during a postulated DBA."

The design is in compliance with this position.

(f) "The volumetric air flow rate of a single cleanup train should be limited to approximately 30,000 ft^3/min. If a total system air flow in excess of this rate is required, multiple trains should be used. For ease of maintenance, a filter layout three HEPA filters high and ten wide is preferred."

The design is in compliance with this position.

(g) "The ESF atmosphere cleanup system should be instrumented to signal, alarm, and record pertinent pressure drops and flow rates at the control room."

The design is in compliance with this position. Filter train exhaust flow and reactor building differential pressure are indicated and appropriately annunciated in the main control room. Pertinent pressure drops across the individual components of the filter train are indicated at a local rack and main control room.

(h) "The power supply and electrical distribution system for the ESF atmosphere cleanup system described in Section C.2.a above [one that is used to mitigate accident doses] should be designed in accordance with Regulatory Guide 1.32. All instrumentation and equipment controls should be designed to IEEE-279. The ESF system should be qualified and tested under Regulatory Guide 1.89. To the extent applicable, Regulatory Guides 1.30, 1.100, and 1.118 and IEEE-334 should be considered in the design."

The design is in compliance with this position. Commitments for all except IEEE-334 are provided in Chapters 7, 8 and 17 and Sections 3.10 and 3.11. IEEE-334 is applied to the SGTS per this Regulatory Guide.

(i) “Unless the applicable engineered-safety-feature atmosphere cleanup system operates continuously during all times that a DBA can be postulated to occur, the system should be automatically activated upon the occurrence of a DBA by (1) a redundant engineered-safety-feature signal (i.e., temperature, pressure) or (2) a signal from redundant Seismic Category I radiation monitors.”

The design is in compliance with this position.

(j) “To maintain radiation exposures to operating personnel as low as is reasonably achievable during plant maintenance, ESF atmosphere cleanup system should be designed to control leakage and facilitate maintenance in accordance with the guidelines of Regulatory Guide 8.8. The ESF atmosphere cleanup train should be totally enclosed. Each train should be designed and installed in a manner that permits replacement of the train as an intact unit or as a minimum number of segmented sections without removal of individual components.”

The design is in compliance with this position.

(k) “Outdoor air intake openings should be equipped with louvers, grills, screens, or similar protective devices to minimize the effects of high winds, rain, snow, ice, trash, and other containments on the operation of the system. If the atmosphere surrounding the plant could contain significant environmental contaminants, such as dusts and residues from smoke cleanup systems from adjacent coal burning power plants or industry, the design of the system should consider these contaminants and prevent them from affecting the operation of any ESF atmosphere cleanup system.”

The ABWR SGTS has no outdoor air intakes, taking suction only from within secondary containment. Secondary containment air is filtered by the HVAC system.

(l) “ESF atmosphere cleanup system housings and ductwork should be designed to exhibit on test a maximum total leakage rate as defined in Section 4.12 of ANSI N509-1976. Duct and housing leak tests should be performed in accordance with the provisions of Section 6 of ANSI N510-1975.”

The design is in compliance with this position.

(3) Component Design Criteria and Qualification Testing

(a) “Demisters should be designed, constructed, and tested in accordance with the requirements of Section 5.4 of ANSI N509-1976. Demisters should meet Underwriters’ Laboratories (UL) Class 1 requirements.”

The design is in compliance with this position.

(b) “Air heaters should be designed, constructed, and tested in accordance with the requirements of Section 5.5 of ANSI N509-1976.”

The design is in compliance with this position.

(c) “Materials used in the prefilters should withstand the radiation levels and environmental conditions prevalent during the postulated DBA. Prefilters should be designed, constructed, and tested in accordance with the provisions of Section 5.3 of ANSI N509-1976.”

The design is in compliance with this position.

(d) “The HEPA filters should be designed, constructed, and tested in accordance with Section 5.1 of ANSI N509-1976. Each HEPA filter should be tested for penetration of dioctyl phthlate (DOP) in accordance with the provisions of MIL-F-51068 and MIL-STD-282.”

The design is in compliance with this position. The applicable portion of MIL-F-51068 is Section 3.4.1. The applicable portions of MIL-STD-282 are Methods 102.1, 102.8 and 102.9.1.

(e) “Filter and adsorber mounting frames should be constructed and designed in accordance with the provisions of Section 5.6.3 of ANSI N509-1976.”

The design is in compliance with this position.

(f) “Filter and adsorber banks should be arranged in accordance with the recommendations of Section 4.4 of ERDA 76-21.”

The design is in compliance with this position.

(g) “System filter housings, including floors and doors, should be constructed and designed in accordance with the provisions of Section 5.6 of ANSI N509-1976.”

The design is in compliance with this position.

(h) “Water drains should be designed in accordance with the recommendations of Section 4.5.8 of ERDA 76-21.”

The design is in compliance with this position.

(i) “The adsorber section of the ESF atmosphere cleanup system may contain any adsorbent material demonstrated to remove gaseous iodine (elemental iodine and organic iodides) from air at the required efficiency. Since impregnated activated carbon is commonly used, only this adsorbent is discussed in this guide.”

Impregnated activated carbon is used in the ABWR SGTS design.

> "Each original or replacement batch of impregnated activated carbon used in the adsorber section should meet the qualification and batch test results summarized in Table 5.1 of ANSI N509-1976. In this table, a 'qualification test' should be interpreted to mean a test that establishes the suitability of a product for a general application, normally a one-time test reflecting historical typical performance of material. In this table, a 'batch test' should be interpreted to mean a test made on a production batch of product to establish suitability for a specific application. A 'batch of activated carbon' should be interpreted to mean a quantity of material of the same grade, type, and series that has been homogenized to exhibit, within reasonable tolerance, the same performance and physical characteristics and for which the manufacturer can demonstrate by acceptable tests and quality control practices such uniformity."

The test requirements for the adsorber section will comply with this position.

> "All material in the same batch should be activated, impregnated, and otherwise treated under the same process conditions and procedures in the same process equipment and should be produced under the same manufacturing release and instructions. Material produced in the same charge of batch equipment constitutes a batch; material produced in different charges of the same batch equipment should be included in the same batch only if it can be homogenized as above. The maximum batch size should be 350 ft^3 of active carbon."

The test requirements will comply with this position.

> "If an adsorbent other than impregnated activated carbon is proposed or if the mesh size distribution is different from the specification in Table 5.1 of ANSI N509-1976, the proposed adsorbent should have demonstrated the capability to perform as well as or better than activated carbon in satisfying the specifications in Table 5.1 of ANSI N509-1976."

Impregnated activated carbon is used in the ABWR SGTS design. The performance requirements of Table 5-1 of ANSI N509 will be met.

> "If impregnated activated carbon is used as the adsorbent, the adsorber system should be designed for an average atmosphere residence time of 0.25 sec per two inches of adsorbent bed. The adsorption unit should be designed for a maximum loading of 2.5 mg of total iodine (radioactive plus stable) per gram of activated carbon. No more than 5% of impregnant (50 mg of impregnant per gram of carbon) should be used. The radiation stability of the type of carbon

specified should be demonstrated and certified (see Section C.1.b of this guide for the design source term)."

The design is in compliance with this position.

(j) "Adsorber cells should be designed, constructed, and tested in accordance with the requirements of Section 5.2 of ANSI N509-1976."

The design is in compliance with this position.

(k) "The design of the adsorber section should consider possible iodine desorption and adsorbent auto-ignition that may result from radioactivity-induced heat in the adsorbent and concomitant temperature rise. Acceptable designs include a low-flow air bleed system, cooling coils, water sprays for the adsorber section, or other cooling mechanisms. Any cooling mechanism should satisfy the single-failure criterion. A low-flow air bleed system should satisfy the single-failure criterion for providing low-humidity (less than 70% relative humidity) cooling air flow."

The design is in compliance with this position. The design utilizes cooling process fans for any necessary cooling of the charcoal.

(l) "The system fan, its mounting, and the ductwork connections should be designed, constructed, and tested in accordance with the requirements of Sections 5.7 and 5.8 of ANSI N509-1976."

The design is in compliance with this position.

(m) "The fan or blower used on the ESF atmosphere cleanup system should be capable of operating under the environmental conditions postulated, including radiation."

The design is in compliance with this position.

(n) "Ductwork should be designed, constructed, and tested in accordance with the provisions of Section 5.10 of ANSI N509-1976."

The design is in compliance with this position.

(o) "Ducts and housings should be laid out with a minimum of ledges, protrusions, and crevices that could collect dust and moisture and that could impede personnel or create a hazard to them in the performance of their work. Straightening vanes should be installed where required to ensure representative air flow measurement and uniform flow distribution through cleanup components."

The design is in compliance with this position.

"Dampers should be designed, constructed, and tested in accordance with the provisions of Section 5.9 of ANSI N509-1976."

The design is in compliance with this position.

(4) Maintenance

(a) "Accessibility of components and maintenance should be considered in the design of ESF atmosphere cleanup systems in accordance with the provisions of Section 2.3.8 of ERDA 76-21 and Section 4.7 of ANSI N509-1976."

The design is in compliance with this position.

(b) "For ease of maintenance, the system design should provide for a minimum of three feet from mounting frame to mounting frame between banks of components. If components are to be replaced, the dimension to be provided should be the maximum length of the component plus a minimum of three feet."

The design is in compliance with this position.

(c) "The system design should provide for permanent test probes with external connections in accordance with the provisions of Section 4.11 of ANSI N509-1976."

The design is in compliance with this position.

(d) "Each ESF atmosphere cleanup train should be operated at least 10 hours per month, with the heaters on (if so equipped), in order to reduce the buildup of moisture on the adsorbers and HEPA filters."

The design is in compliance with this position.

(e) "The cleanup components (i.e., HEPA filters, prefilters, and adsorbers) should not be installed while active construction is still in progress."

Installation of the SGTS will comply with this position.

(5) In-Place Testing Criteria

(a) "A visual inspection of the ESF atmosphere cleanup system and all associated components should be made before each in-place air flow distribution test, DOP test, or activated carbon adsorber section leak test in accordance with the provisions of Section 5 of ANSI N510-1975."

The system test procedures will comply with this position.

(b) “The air flow distribution to the HEPA filters and iodine adsorbers should be tested in place for uniformity initially and after maintenance affecting the flow distribution. No velocity reading shall exceed ±20% of the calculated average. The testing should be conducted in accordance with the provisions of Section 9 of “Industrial Ventilation” and Section 8 of ANSI N510-1975.”

Acceptance tests, performed after completion of initial construction and after any system modifications or repair (per Table 1 of ANSI N510), will comply with this position. The guidance in “Testing of Ventilation Systems,” Section 9 of “Industrial Ventilation,” and ANSI N510 will be applied to any testing performed.

(c) “The in-place DOP test for HEPA filters should conform to Section 10 of ANSI N510-1975. HEPA filter sections should be tested in place (1) initially, (2) at least once per 18 months thereafter, and (3) following painting, fire, or chemical release in any ventilation zone communicating with the system to confirm a penetration of less than 0.05% at rated flow. An engineered safety-feature air filtration system satisfying this condition can be considered to warrant a 99% removal efficiency for particulates in accident dose evaluations. HEPA filters that fail to satisfy this condition should be replaced with filters qualified pursuant to regulatory position C.3.d of this guide. If the HEPA filter bank is entirely or only partially replaced, an in-place DOP test should be conducted.”

The surveillance test procedure will comply with this position. Technical Specification 3.6.4.3 (Chapter 16) complies with this position.

“If any welding repairs are necessary on, within, or adjacent to the ducts, housing, or mounting frames, the filters and adsorbers should be removed from the housing during such repairs. The repairs should be completed prior to periodic testing, filter inspection, and in-place testing. The use of silicone sealants or any other temporary patching material on filters, housing, mounting frames, or ducts should not be allowed.”

The SGTS maintenance procedures will comply with this position.

(d) “The activated carbon adsorber section should be leak tested with a gaseous halogenated hydrocarbon refrigerant in accordance with Section 12 of ANSI N510-1975 to ensure that bypass leakage through the adsorber section is less than 0.05%. After the test is completed, air flow through the unit should be maintained until the residual refrigerant gas in the effluent is less than 0.01 ppm. Adsorber leak testing should be conducted (1) initially, (2) at least once per 18 months thereafter, (3) following removal of an adsorber sample for laboratory testing if the integrity of the adsorber section is affected, and (4)

following painting, fire, or chemical release in any ventilation zone communicating with the system."

Surveillance testing is provided to comply with this position.

(6) Laboratory Testing Criteria for Activated Carbon

(a) "The activated carbon adsorber section of the ESF atmosphere cleanup system should be assigned the decontamination efficiencies given in Table 2 for elemental iodine and organic iodides if the following conditions are met:"

The carbon bed is 15 cm deep. Per Table 2, the decontamination efficiency for bed depths 10 cm or greater is 99%. The radiological analyses described in Subsections 15.6.5 and 15.7.4 assume a charcoal adsorber efficiency of less than 99%.

(1) "The adsorber section meets the conditions given in Regulatory Position C.5.d of this guide."

As stated previously, the ABWR SGTS complies with Position C.5.d.

(2) "New activated carbon meets the physical property specifications given in Table 5.1 of ANSI N509-1976."

Activated carbon installed in the SGTS will be covered by purchase requirements to meet the physical properties specified in Table 5-1 of ANSI N509.

(3) "Representative samples of used activated carbon pass the laboratory tests given in Table 2.

Surveillance testing is provided to comply with this position. This position is interpreted as follows. Representative samples of used activated carbon will be laboratory tested with a frequency defined in Footnote c of Table 2 and as reflected in the technical specifications. Also, per Footnote c of Table 2, a representative sample is defined in Position C.6.b. Testing will be performed at a relative humidity of 70% per ASTM D3803. The test acceptance criterion will be a methyl iodide penetration of less than 0.175%. ASTM D3803 is cited in Table 5-1 of ANSI N509-1980 for tests equivalent to those specified in Test 5.b of ANSI N509-1976.

"If the activated carbon fails to meet any of the above conditions, it should not be used in engineered-safety-feature adsorbers."

The activated carbon for the SGTS will meet the conditions of Position 6.a(i), (ii) and (iii).

(b) "The efficiency of the activated carbon adsorber section should be determined by laboratory testing of representative samples of the activated carbon exposed

> simultaneously to the same service conditions as the adsorber section. Each representative sample should be not less than two inches in both length and diameter, and each sample should have the same qualification and batch test characteristics as the system adsorbent. There should be a sufficient number of representative samples located in parallel with the adsorber section to estimate the amount of penetration of the system adsorbent throughout its service life. The design of the samplers should be in accordance with the provisions of Appendix A of ANSI N509-1976. Where the system activated carbon is greater than two inches deep, each representative sampling station should consist of enough two-inch samples in series to equal the thickness of the system adsorbent. Once representative samples are removed for laboratory test, their positions in the sampling array should be blocked off."

The detailed design will be in compliance with this position.

> "Laboratory tests of representative samples should be conducted, as indicated in Table 2 of this guide, with the test gas flow in the same direction as the flow during service conditions. Similar laboratory tests should be performed on an adsorbent sample before loading into the adsorbers to establish an initial point for comparison of future test results. The activated carbon adsorber section should be replaced with new unused activated carbon meeting the physical property specifications of Table 5.1 of ANSI N509-1976 if (1) testing in accordance with the frequency specified in Footnote c of Table 2 results in a representative sample failing to pass the applicable test in Table 2, or (2) no representative sample is available for testing."

The SGTS design and testing will comply with this position. Physical property testing is addressed in the response to Position C.6.a(2).