

EXELON GENERATION COMPANY, LLC
DOCKET NOS. 50-352, 50-353, and 72-65
SAFETY EVALUATION REPORT
RELATED TO TS ALTERNATIVE REQUEST
FOR THE TN-1004 SYSTEM

1.0 Introduction

By letter dated April 8, 2019, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19127A247), as supplemented August 8, 2019, and August 27, 2019 (ADAMS Accession Nos. ML19224A052 and ML19239A256 respectively), Exelon Generation Company, LLC (Exelon) requested approval of a one-time alternative for the Limerick Generating Station, Units 1 and 2 Independent Spent Fuel Storage Installation (ISFSI) pursuant to Standardized NUHOMS® Certificate of Compliance (CoC) No. 1004 Renewed, Amendment No. 14, Technical Specification (TS) 4.1 to use two Dry Shielded Canisters (DSCs) equipped with BORAL® neutron absorber plates that were subject to different acceptance testing requirements than those specified in CoC No. 1004 Renewed, Amendment No. 14. CoC No. 1004 Renewed, Amendment No. 14, TS 4.1, states that alternatives to these requirements (i.e., TS 4.1 requirements) may be authorized by the Director of the Office of Nuclear Material Safety and Safeguards, or their designee. The applicant's request should demonstrate that the alternative provides an acceptable level of quality and safety or compliance with the specified requirements creates hardship or unusual difficulty without a compensating increase in quality and safety.

The TS 4.1 alternative request involves the testing requirements and acceptance criteria for BORAL® neutron absorber plates. In this case, Exelon requested TN re-certify two model 61BT DSCs (serial numbers LGS-61B-007A and -008A), which had been certified for use by TN Americas LLC under Standardized NUHOMS® CoC No. 1004, Amendment No. 9, in accordance with CoC No. 1004 Renewed, Amendment No. 14 as 61BTH Type 1 DSCs. Exelon identified that approval of this alternative request was needed for a planned loading in Fall 2020.

Because there are no substantive design differences between the model 61BT and the model 61BTH Type 1 DSCs, TN Americas LLC compared the documents identifying the as-fabricated characteristics and conditions of the BORAL® neutron absorber plates used in the subject DSCs to the requirements and acceptance criteria for BORAL® neutron absorber plates in CoC No. 1004 Renewed, Amendment No. 14. Their review determined the following areas where the two subject DSCs differ from the requirements of CoC No. 1004 Renewed, Amendment No. 14, TS 4.1:

1. "The sampling rate for B10 volume density measurements shall be such that there is at least one density measurement for each 2000 square inches of final product in each lot." The rate of sampling for the subject DSC BORAL® production campaign yielded one specimen for approximately 3200 square inches of product.

2. "The method of measurement of B10 volume density [by chemical and isotopic analysis] shall be qualified against neutron attenuation testing." The chemical analysis method used by the BORAL[®] supplier was not benchmarked against neutron attenuation testing.
3. "If a goodness-of-fit test demonstrates that the sample comes from a normal population, the one-sided tolerance limit for a normal distribution may be used ... Otherwise a nonparametric (distribution-free) method of determining the one-sided tolerance limit may be used." The BORAL[®] supplier used the normal distribution tables without subjecting the areal density data to a goodness-of-fit test.

2.0 Discussion

The staff reviewed the justification for the acceptance of two DSCs (serial numbers LGS-61B-007A and LGS-61B-008A) fabricated per the BORAL[®] specifications in CoC No. 1004, Renewed Amendment No. 9 for use under CoC No. 1004, Renewed Amendment 14. The applicant clarified that all the requirements for the BORAL[®] material, as stated in CoC No. 1004, Renewed Amendment No. 9, were satisfied without any exception.

The applicant identified the pertinent acceptance testing for the BORAL[®] material under Renewed Amendment No. 14 relative to the requirements in Renewed Amendment No. 9. The review identified three non-conformances with the requirements under Renewed Amendment No. 14 as noted above. These non-conformances included (1) a sampling rate for Boron-10 (B-10) volume density for each 2000 square inches of final product in each lot, (2) neutron attenuation was not used for benchmarking the chemical and isotopic characterization method used for B-10 quantification, and (3) a normal distribution for the areal density data was assumed without a goodness-for-fit test. The staff used Interim Staff Guidance (ISG)-23 "Division of Spent Fuel Storage and Transportation Interim Staff Guidance Document 23, ISG-23," (ADAMS Accession No. ML100191103) in support of the review of the applicant's justification for acceptance of the two DSCs.

Regarding the sampling rate, the staff has historically accepted sampling plans where at least one neutron transmission measurement is taken for every 2000 square inches of neutron poison plate material in each lot as identified in ISG-23. The staff reviewed the basis for the sampling rate (approximately every 3160 square inches) for B-10 density characterization (by wet chemistry and isotopic analysis) of the subject DSCs. The applicant provided the BORAL[®] manufacturer's proprietary quality assurance procedure which clarified the basis for the sampling frequency (ADAMS Accession No. ML19239A254). The quality assurance procedure explained that the BORAL[®] manufacturer estimated the mean and standard deviation of a normal population by measuring the mean and standard deviation of a random sample of ingots from the population. The BORAL[®] manufacturer used the mean and standard deviation for a normal population to identify a minimum value (i.e., a lower tolerance limit) above which 95% of the population exists with 95% confidence (i.e., 95/95) for B-10 areal density (gm/cm²). The manufacturer subsequently established a sampling frequency to statistically ensure that the lower tolerance limit for a lot exceeds the specified minimum B-10 areal density with 95/95 confidence. Therefore, the staff considers that the sampling rate used for B-10 density characterization (by wet chemistry and isotopic analysis) of the subject DSCs is reasonable. Further, the staff notes that there is no evidence that this sampling rate represents a safety issue per the prior approval under Renewed Amendment No. 9.

Regarding the lack of benchmarking of the wet chemistry and isotopic characterization method by neutron attenuation, the applicant identified that there is no such requirement in Renewed Amendment No. 9. However, ISG-23 states that, for neutron absorbing materials for which 75-

percent credit is taken (as is the case in the subject DSCs), direct neutron attenuation measurements are generally expected to be part of the qualification program of the chemical and isotopic characterization method. Therefore, the applicant referenced the safety basis for taking credit for only 75-percent the minimum B-10 content in the criticality evaluation of the subject DSCs which was based on specifications in Chapter K.9 of the Updated Final Safety Analysis Report for Renewed Amendment No. 9 (ADAMS Accession No. ML18079A007). The staff considers that the lack of benchmarking does not represent a safety issue since (1) the sampling rate for wet chemistry is reasonable, as discussed above, (2) only 75-percent of the neutron absorbing material is credited in the criticality safety analyses of these DSCs and (3) there is no evidence that the lack of benchmarking represents a safety issue per the prior approval under Renewed Amendment No. 9.

Regarding the assumption of a normal distribution for the areal density, ISG-23 does not identify that a goodness-for-fit test needs to be performed in support of this assumption. The applicant provided the procedure for in-process and final inspection of the BORAL[®] used in the subject DSCs. That procedure described and justified the acceptance process for demonstrating 95-percent confidence that 95-percent of the BORAL[®] inspected complies with the specified B-10 areal density. The applicant tested 100-percent of the BORAL[®] sheets predicted from the first 100 ingots at the beginning of a production run. The applicant reduced the areal density characterization frequency only if the average minus two standard deviations of the ingots tested met the specification. Therefore, the staff considers that the assumption of a normal distribution is adequate since only 75-percent of the neutron absorbing material is credited in the criticality safety analyses of these DSCs and there is no evidence that the lack of this assumption represents a safety issue per the prior approval under Renewed Amendment No. 9.

The thermal performance technical review focused on the relative contribution of the BORAL[®] plates to the effective thermal conductivity design basis requirement. The applicant provided design basis calculations considering two scenarios consisting of a single plate configuration with BORAL[®] only and a dual plate configuration consisting of a BORAL[®] plate and aluminum 1100 plate. This design basis calculation yielded the minimum thermal conductance for both single and paired plate systems.

Subsequently, the applicant provided a calculation, which assumed the BORAL[®] thermal conductivity was zero, considering the as-built paired plate configuration for the 61BT DSCs LGS-61B-007A and -008A. This calculation yielded the as-built thermal conductivity considering only the thermal contribution of the aluminum. The reported thermal conductivity for the as-built dual plate system exceeded the required minimum design basis thermal conductivity for a dual plate configuration; thus, the as-built configuration can effectively reject the decay heat as specified by the design. Further, since the thermal conductivity of BORAL[®] was ignored, the staff finds that there is reasonable assurance of adequate protection since this is a conservative assumption which will result in additional heat rejection capacity that was not credited.

3.0 Conclusion

The staff finds that the applicant provided documentation which demonstrated re-certification of DSCs LGS-61B-007A and LGS-61B-008A as 61BTH Type 1 DSCs under CoC No. 1004 Renewed, Amendment No. 14 versus 61BT DSCs under CoC No. 1004, Amendment No. 9 meets the regulatory requirements of 10 CFR Part 72.