

April 17, 2001

Mr. R. M. Krich
Vice President - Regulatory Services
Exelon Generation Company, LLC
1400 Opus Place
Downers Grove, Illinois 60515-5701

SUBJECT: EXEMPTION FROM 10 CFR 72.212 AND 72.214, DOCKET NO. 72-37
(TAC NO. L23273)

Dear Mr. Krich:

This is in response to your letters dated January 11, February 16, and March 2, 2001, requesting exemption to 10 CFR 72.212(a)2, 72.212(b)(2)(i)(A) and 72.214, pursuant to 10 CFR 72.7. In your letters, you requested an exemption from the conditions in Certificate of Compliance 1014 (the Certificate), Appendix B, Table 2.1-3 and Items 3.4.6.a, 3.4.6.b, 3.4.6.d, for the HI-STORM 100 Cask System, listed in 10 CFR 72.214. This will allow HI-STORM 100 Cask Systems to be loaded with fuel assemblies with fuel characteristics that differ from those listed in the HI-STORM 100 Certificate of Compliance and placed on concrete storage pads with a concrete compressive strength of less than or equal to 6,000 psi at 28 days.

The Dresden Nuclear Power Station (Dresden) Unit 2 spent fuel pool contains a number of Dresden Unit 1 spent fuel assemblies. We understand that Exelon Generation Company, LLC (EGC) needs to begin loading spent fuel assemblies into storage casks in Spring 2001 to maintain full-core offload capability in the Unit 2 spent fuel pool once new fuel arrives for Summer 2001 refueling outage. However, the fuel assemblies EGC intends to load and the storage pads at the Dresden Independent Spent Fuel Storage Installation (ISFSI) are not in conformance with the current Certificate. Based on your assertions in a February 27, 2001, public meeting regarding the imminent loss of full-core offload capability, we have processed these exemptions on an urgent bases. We believe that proper planning could have obviated the need for these exemption requests. Additionally, technical review resources were diverted to address this high priority action resulting in delays to scheduled casework and impacts on other stakeholders.

The requested exemption will allow HI-STORM 100 Cask Systems to be loaded with fuel assemblies that have characteristics that differ from those listed in the HI-STORM 100 Certificate of Compliance, Appendix B, Table 2.1-3 and allow items 3.4.6.a, 3.4.6.b, and 3.4.6.d to be revised to require (1) a concrete thickness of less than or equal to 28 inches, (2) a concrete compressive strength of less than or equal to 6,000 psi at 28 days, and (3) soil effective modulus of elasticity of less than or equal to 16,000 psi. After reviewing the information provided in your letters the staff has determined that the safety basis for loading fuel assemblies with the revised fuel assembly design characteristics and for using cask storage pads with the revised characteristics is adequate to grant the exemption. The technical bases is provided in the enclosed safety evaluation.

NRC staff evaluated the public health and safety and environmental impacts of the proposed exemption and determined that granting the exemption would not result in any significant impacts. For this action, an Environmental Assessment and Finding of No Significant Impact have been prepared and published in the Federal Register (66 FR 18820). A copy of the Federal Register Notice was provided to you by letter dated, April 3, 2001. Based on the foregoing considerations, the staff has determined that granting the proposed exemption from the provisions of 10 CFR 72.212(a)(2), 72.212(b)(2)(i)(A), and 72.214 is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest.

Specifically, this exemption permits EGC to deviate from the requirements of Certificate of Compliance 1014, Appendix B, Table 2.1-3 such that EGC will be authorized to load HI-STORM 100 Casks Systems with fuel assemblies with the following characteristics:

- Fuel assembly maximum design initial uranium mass ≤ 110 kg/assembly
- Fuel assembly array/class 6x6A fuel rod clad ID ≤ 0.5105 inches
- Fuel assembly array/class 6x6A fuel pellet diameter ≤ 0.4980 inches
- Fuel assembly array/classes 6x6A and 6x6B fuel rod pitch ≤ 0.710 inches
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A active fuel length ≤ 120 inches
- Fuel assembly array/classes 6x6A and 6x6B number of fuel rod locations "35 or 36"
- Fuel assembly array/class 8x8A number of fuel rod locations "63 or 64"
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A number of water rods "1 or 0"
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A water rod thickness ≥ 0 inches

The remainder of the fuel assembly characteristics in Table 2.1-3 of Appendix B to the Certificate remain in effect. Additionally, this exemption permits EGC to deviate from the requirements of Certificate of Compliance 1014, Appendix B, such that EGC will be authorized to load HI-STORM 100 Casks Systems loaded with spent nuclear fuel generated at Dresden, on cask storage pads that include the following characteristics:

- (1) Concrete Thickness: ≤ 28 inches
- (2) Concrete Compressive Strength: $\leq 6,000$ psi at 28 days
- (3) Soil Effective Modulus of Elasticity: $\leq 16,000$ psi

The storage pad characteristics specified above replace those currently specified in Certificate of Compliance 1014, Appendix B, Item 3.4.6.a, 3.4.6.b, and 3.4.6.d. EGC is hereby granted this exemption subject to the following conditions:

- (1) EGC must perform the 10 CFR 72.212 evaluations in accordance with the terms of the general license provisions of 10 CFR Part 72, Subpart K, prior to loading any HI-STORM 100 Cask System and placing the cask on storage pads with the characteristics specified above.
- (2) EGC must inform NRC, within 30 days, if any of the conditions of this exemption cannot be met.
- (3) EGC must meet all other conditions of Certificate of Compliance 1014.

R. M. Krich

-3-

If you have any questions, please contact Christopher Jackson of my staff at (301)415-2947. Any future correspondence related to this action should reference Docket 72-37 and TAC No. L23273.

Sincerely,

/s/ /RA/

E. William Brach, Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket Nos.: 72-37, 72-1014, 50-10

cc: Mr. K.P. Singh, President
Holtec International

Service List

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-3-

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E. William Brach, Director
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Docket Nos.: 72-37, 72-1014, 50-10

cc: Mr. K.P. Singh, President
Holtec International

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SAFETY EVALUATION REPORT
Docket No. 72-37
DRESDEN INDEPENDENT SPENT FUEL STORAGE INSTALLATION
HI-STORM 100 EXEMPTION

SUMMARY

By letters dated January 11, February 16, and March 2, 2001, Exelon Generation Company, LLC, (EGC or Exelon) requested exemptions to 10 CFR 72.212(a)2, 72.212(b)(2)(i)(A) and 72.214, pursuant to 10 CFR 72.7. Exelon requested an exemption from the conditions in Certificate of Compliance 1014 (the Certificate), Appendix B, Table 2.1-3 and Items 3.4.6.a, 3.4.6.b, 3.4.6.d, for the HI-STORM 100 Cask System, listed in 10 CFR 72.214. Specifically, this exemption permits EGC to deviate from the requirements of Certificate of Compliance 1014, Appendix B, Table 2.1-3 such that EGC will be authorized to load HI-STORM 100 Casks Systems with fuel assemblies with the following characteristics:

- Fuel assembly maximum design initial uranium mass \leq 110 kg/assembly
- Fuel assembly array/class 6x6A fuel rod clad ID \leq 0.5105 inches
- Fuel assembly array/class 6x6A fuel pellet diameter \leq 0.4980 inches
- Fuel assembly array/classes 6x6A and 6x6B fuel rod pitch \leq 0.710 inches
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A active fuel length \leq 120 inches
- Fuel assembly array/classes 6x6A and 6x6B number of fuel rod locations "35 or 36"
- Fuel assembly array/class 8x8A number of fuel rod locations "63 or 64"
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A number of water rods "1 or 0"
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A water rod thickness \geq 0 inches

Additionally, this exemption permits EGC to deviate from the requirements of Certificate of Compliance 1014, Appendix B, such that EGC will be authorized to load HI-STORM 100 Casks Systems loaded with spent nuclear fuel generated at Dresden, on cask storage pads that include the following characteristics:

- (4) Concrete Thickness: \leq 28 inches
- (5) Concrete Compressive Strength: \leq 6,000 psi at 28 days
- (6) Soil Effective Modulus of Elasticity: \leq 16,000 psi

The issues associated with these exemptions affect the structural, thermal, shielding, and criticality aspects of the design criteria. All other aspects of the design criteria, including, confinement and materials are unaffected. As a result, this safety evaluation report only addresses the structural, thermal, shielding, and criticality aspects of the cask design and operation.

REFERENCES

1. Letter from R. M. Krich, Commonwealth Edison Company, Subject, "Request for Exemption from 10 CFR 72.212, 'Conditions of general license issued under 10 CFR 2.10,' and 10 CFR 214, 'List of approved spent fuel storage casks,' Regarding the Conditions of Use for the HI-

STORM 100 Cask System and for the HI-STAR 100 Cask System,” dated January 11, 2001 (RS-01-03).

2. Letter from R. M. Krich, Commonwealth Edison Company, Subject, “Request for Exemption from 10 CFR 72.212, ‘Conditions of general license issued under 10 CFR 2.10,’ and 10 CFR 214, ‘List of approved spent fuel storage casks,’ Regarding the Conditions of Use for the HI-STORM 100 Cask System,” dated January 11, 2001 (RS-01-04).

3. Letter from R. M. Krich, Exelon Generation Company, LLC, Subject, “Request for Additional Information for the HI-STORM 100 Cask System Exemption Request,” dated February 16, 2001 (RS-01-025).

4. Letter from R. M. Krich, Exelon Generation Company, LLC, Subject, “Request for Additional Information for the HI-STORM 100 Cask System Exemption Request,” dated March 2, 2001 (RS-01-038).

STRUCTURAL

The current certificate for the Holtec HI-STORM 100 Cask System, dated May 4, 2000, requires that all independent spent fuel storage installation (ISFSI) pads be designed to meet a specific value range of a group of detailed parameters, including an upper limit on the pad thickness, an upper limit on the concrete compressive strength at 28-days, the value of the reinforcing bar yield strength for an ASTM material (a minimum yield strength specification), and an upper limit on the soil effective modulus of elasticity. The applicant has requested (Reference 1) an exemption from these specific parameters, specified in Section 3.4.6 of Appendix B of the Certificate and instead wants these parameters to be replaced by the parameters described above.

This exemption request is based on the results of an in-depth investigation performed by Lawrence Livermore National Laboratory (LLNL) for the U.S. Nuclear Regulatory Commission and reported in NUREG/CR-6608. The single relevant parameter identified in the LLNL study is that the performance of an ISFSI pad and the surrounding supporting soil media, as a system, not impose a deceleration value under all design basis drop and non-mechanistic tipover events that exceeds the critical design deceleration value of the cask system. Thus, it is the performance characteristics of the entire impacted system along with a specific impacting cask that determines the deceleration loading on that specific cask and its internals. For the HI-STORM 100 Cask System this loading limit is defined at the top of the basket and has been determined to need to be less than or equal to 45-g, as specified in Table 3.1-21 of the HI-STORM 100 Final Safety Analysis Report (FSAR), dated July 19, 2000. An ISFSI pad system with the parameters and values currently as specified in Subsection 3.4.6 of Appendix B of the Certificate results in a deceleration less than the 45-g's and is acceptable as documented in Table 2.2.9 of the FSAR. In general, based on the LLNL results, there are a number of combinations of the parameters that are also acceptable. In addition to the value of these original parameters (now referred to as Set A), a second set of parameter values (referred to as Set B) has been developed that have been shown to also limit the critical deceleration value to less than 45-g. As stated in Reference 3, the Set B parameters reflect the bounding conditions at the applicant's Dresden ISFSI facility. Based on this information, the applicant has requested the exemption to the provisions of Appendix B, Item 3.4.6, of the Certificate.

As presented in the Reference 3, the HI-STORM 100 Cask System has been evaluated using the second set of cask pad parameters described above. Finite element analyses have been performed on this set (Set B) of values for the pad parameters using the same analysis methodology originally used to confirm that the cask drop and the tipover events will result in cask decelerations less than or equal to the design basis 45-g limit. The results of this analysis for the parameters to be used by the applicant at the Dresden ISFSI (Set B), as well as the original set (Set A) are provided in Table A.4 of Attachment A to the exemption request (Reference 3). The computed decelerations at the top of the basket are all less than the 45-g. The staff concludes that use of 45-g deceleration limit, as specified in the current HI-STORM 100 Cask System FSAR is an appropriate design basis g-load to use as the bases for the exemption request. As a result, there is reasonable assurance that no structural failure of the cask system will occur after a postulated accidental drop or a non-mechanistic tipover event.

Based on these analyses results, additional site-specific cask impact analyses are not required when the ISFSI pads and subgrade are in compliance with either of the two sets (A or B) of the values of the ISFSI design parameters provided in Table A.1 of the exemption request. As provided in Reference 3, it is stated that all installed Dresden Nuclear Power Station concrete pads are bounded by the Set B values. Although a site-specific impact analysis is not needed because of these values and the results produced have been found to be acceptable, 10 CFR 72.212(b)(2)(ii) continues to require a structural analysis of the ISFSI pad be performed to ensure that the ISFSI pads are adequately designed for the other HI-STORM 100 Cask System loads and the foundation of the ISFSI site. The ISFSI pad structural analysis should be included in the 10 CFR 72.212 evaluations performed by the applicant.

Therefore, the staff finds that the exemption to Subsection 3.4.6 of Appendix B of Certificate of Compliance No. 1014, dated May 4, 2000 is acceptable, based on NUREG/CR-6608 and the results of the analyses and results for parameter value Set B, as stated in Attachment A of Reference 3, in limiting the maximum deceleration imposed on the Holtec HI-STORM 100 Cask System to less than or equal to 45-g at the top of the basket. This location was previously established as the critical point under the design basis conditions.

In conclusion, the exemption does not change the structural design aspects of the HI-STORM 100 Cask System, nor will it affect the ability of the spent fuel package to meet the requirements of 10 CFR Part 72. The exemption is granted under 10 CFR 72.7 on the basis that the exemption will not endanger life or property or the common defense and security and is otherwise in the public interest.

THERMAL

The applicant requested the exemption to store boiling water reactor (BWR) fuel assemblies having characteristics outside the specified limits allowed by appendix B, Table 2.1-3 for the fuel assembly array/classes 6x6A, 6x6B, and 8x8A. Specifically an increase in the permitted mass of uranium per fuel assembly from ≤ 108 Kg/assembly to a maximum design initial uranium mass of ≤ 110 kg/assembly. Increasing the maximum design initial uranium mass will allow the loading of fuel assemblies currently outside the existing specification for maximum fuel uranium mass. Additionally, the applicant states that some of the DNPS fuel assemblies do not meet the current limits for fuel rod clad inner diameter (ID), fuel rod pitch, active length, number of fuel rod locations, number of water rods, and water rod thickness.

The following details the enveloping characteristics of the DNPS fuel assemblies to be stored under this exemption:

- Fuel assembly array/class 6x6A fuel rod clad ID ≤ 0.5105 inches
- Fuel assembly array/class 6x6A fuel pellet diameter ≤ 0.4980 inches
- Fuel assembly array/classes 6x6A and 6x6B fuel rod pitch ≤ 0.710 inches
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A active fuel length ≤ 120 inches
- Fuel assembly array/classes 6x6A and 6x6B number of fuel rod locations "35 or 36"
- Fuel assembly array/class 8x8A number of fuel rod locations "63 or 64"
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A number of water rods "1 or 0"
- Fuel assembly array/classes 6x6A, 6x6B, and 8x8A water rod thickness ≥ 0 inches

The applicant states that the thermal analyses for the above assemblies have been revised to reflect these changes and that the existing analyses remain bounding or are accounted for in the revised analyses. There are no other physical changes to the cask system.

The applicant asserts that increasing the limit for the maximum design initial uranium mass to ≤ 110 kg/assembly does not increase the decay heat load or change the heat transfer characteristics of the cask. The staff agrees that increasing the initial uranium mass will not increase the decay heat load. Similarly the staff confirmed that in the original heat transfer analyses bound the fuel assemblies with increased initial uranium mass. Notably that because the uranium is a solid and the increased uranium mass in the fuel rod is displacing a gas which has a lower conductivity, the conductivity of the fuel rods with the increased fuel mass will more effectively conduct heat out of the fuel assembly and thus the original heat transfer analysis (current HI-STORM 100 FSAR) will bound that of the higher uranium mass fuel assemblies.

The applicant asserts that the changes to the fuel assembly parameter limits do not increase the decay heat load or change the heat transfer characteristics of the cask system. The staff agrees that changes to the fuel assembly parameter limits will not increase the decay heat load. The applicant asserted that the bounding fuel cladding stress for the array/class 6x6A "thin clad" increased from 65.3MPa to 94.1MPa which resulted in a subsequent decrease in the peak cladding temperature limits. This analysis was performed using the same methodology delineated in the current HI-STORM 100 FSAR. The staff reviewed the applicant's calculation for the 6x6 fuel assembly provided in response to staff request for additional information dated February 28, 2001. The staff confirmed through independent calculation that the analyses provide sufficient bases to support the applicant's conclusion that the revised peak cladding temperature limits remain above the peak cladding temperatures calculated for the fuel assemblies in long term storage.

The staff concludes that the thermal design criteria and evaluation delineated in this exemption request provides reasonable assurance that the HI-STORM 100 dry cask storage system will allow the safe storage of the spent fuel defined in this exemption. This finding is reached on the basis of a review that considered 10 CFR Part 72, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

SHIELDING

The applicant requested to store fuel in the HI-STORM 100 that is outside the limits allowed by Appendix B, Table 2.1-3, for the fuel assembly array /classes 6x6A, 6x6B, and 8x8A. The only design parameter change which could affect the shielding aspects of the cask is the increase of the maximum design initial uranium mass. Specifically, the applicant requested to raise the limit from ≤ 108 kg/assembly, to ≤ 110 kg/assembly.

This value is less than the value used in the applicant's existing shielding analysis, and therefore, the proposed change is bounded.

Based on the information provided by the applicant, the staff has reasonable assurance that the Dresden HI-STORM 100 cask will continue to meet the shielding regulatory requirements of 10 CFR Part 72.

CRITICALITY

The applicant requests an exemption to certain fuel parameters for the 6x6A, 6x6B, and 8x8A fuel assembly classes listed in the Certificate of Compliance for the HI-STORM 100 cask system. These fuel parameters have already been approved for storage in the HI-STAR cask system. The parameters were approved during the review of Amendment 1 to Certificate of Compliance 72-1008, which was issued on December 21, 2000.

The HI-STORM 100 cask system consists of a transfer cask, a concrete storage overpack, and a multipurpose canister (MPC). The MPC designs used with the HI-STORM 100 are identical to those previously approved by the staff for the HI-STAR 100 cask system. The transfer cask, the HI-STORM overpack, and the HI-STAR overpack are constructed of different materials. The effectiveness of these materials to reflect neutrons may affect the reactivity of the system; therefore each was explicitly evaluated during the staff's initial review and licensing of the HI-STORM 100. The other parameters affecting the criticality safety of the HI-STORM system are identical to the HI-STAR system. The staff's analysis showed that the overpack and transfer cask reflector materials do not significantly affect the system reactivity.

As can be seen from above, the fuel parameter changes have already been approved for the HI-STAR and the differences between the HI-STORM and HI-STAR casks do not significantly affect the system reactivity. Therefore, the staff has reasonable assurance that the HI-STORM 100 system will remain subcritical, with an adequate safety margin when storing the proposed fuel types.

CONCLUSION

The staff performed a review of the proposed exemption. The staff found that the proposed exemption is consistent with the criticality, shielding, thermal and cask drop and tipover analyses presented in the revised Safety Analyses Report for the HI-STORM 100 Cask System and does not reduce the safety margin. The staff has determined that there is no reduction in the safety margin as a result of loading fuel assemblies with the revised characteristics (as specified above) and placing loaded HI-STORM 100 Cask Systems on storage pads with a

concrete thickness of less than or equal to 28 inches, concrete compressive strength of less than or equal to 6,000 psi at 28 days, and soil effective modulus of elasticity less than or equal to 16,000 psi. The staff has determined that loading fuel assemblies that include revised design characteristics does not pose any increased risk to public health and safety. Based on the foregoing considerations, the staff has determined that granting the proposed exemption from the provisions of 10 CFR 72.212(a)(2), 72.212(b)(2)(i)(A), and 72.214 is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest.

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