Exelon. Generation

NP-10-0009
May 27, 2010

10 CFR 52, Subpart A

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station
Early Site Permit Application Environmental Report Revision
NRC Project Number 0781

References: (1) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Application for Early Site Permit for Victoria County Station, dated March 25, 2010

(2) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Early Site Permit Application Correction Notification, dated May 13, 2010

Exelon Nuclear Texas Holdings, LLC (Exelon) submitted an application for an early site permit (ESP) in Reference 1 for the Victoria County Station (VCS) site. That submittal consisted of six parts as described in the referenced letter.

Exelon subsequently notified the NRC in Reference 2 of an issue impacting the Environmental Report (ER) Sections 5.7.2 and 7.4. This issue involved a conservative error in the length of the Advanced Pressurized Water Reactor (APWR) refueling cycle. As described in Reference 2, the calculations for the APWR design incorrectly used an 18 month refueling cycle assumption instead of the correct value of 24 months in the calculation for the potential consequences from normal and accident shipments of radioactive materials. This resulted in an overestimation of all impacts that depend on the number of trips for shipments of both fresh and spent nuclear fuel for the APWR. Corrections to ER Sections 5.7.2 and 7.4 are shown in Enclosure 1. The corrected values result in lower consequences than those currently shown in the VCS ESP Application (ESPA) ER Tables. This issue does not impact any conclusions in the ER.

It is also noted that the enclosed markups include changes to the APWR radionuclide inventories shown in ER Table 7.4-1. The values for the APWR previously reported in ER Table 7.4-1 were incorrectly based on units of curies per fuel assembly, and have been revised to reflect the units of curies per metric ton uranium (MTU). This change does not impact any conclusions in the ER.

D087
NRO

ER Sections 5.7.2 and 7.4 will be revised as indicated in Enclosure 1 to reflect the above changes. This ER revision will be included in the next ESPA update submittal.

Regulatory commitments established in this submittal are identified in Enclosure 2. If any additional information is needed, please contact David J. Distel at (610) 765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 27th day of May, 2010.

Respectfully,

Marilyn C. Kray

Marilyn C. Kray
Vice President, Nuclear Project Development

Enclosure: (1) Markup Pages of Victoria County Station ESPA
(2) Summary of Regulatory Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO (w/enclosures)
USNRC, Project Manager, VCS, Division of New Reactor Licensing (w/enclosures)
USNRC Region IV, Regional Administrator (w/enclosures)

ENCLOSURE 1

MARKUP PAGES OF VICTORIA COUNTY STATION ESPA

(Exelon Letter to USNRC No. NP-10-0009, dated May 27, 2010)

The attached markup represents Exelon's good faith effort to show how the ESPA will be revised in a future ESPA submittal in response to the additional information described above. However, the same ESPA content may be impacted by revisions to the ESPA, responses to ESPA RAIs, other ESPA changes, editorial or typographical corrections, etc. As a result, the final ESPA content that appears in a future submittal may be somewhat different than as presented herein.

<u>ER Section 5.7 Pages</u>

5.7-2
5.7-9
5.7-10
5.7-13
5.7-14
5.7-26
5.7-28
5.7-30
5.7-33

<u>ER Section 7.4 Pages</u>

7.4-2
7.4-6
7.4-7
7.4-8
7.4-9
7.4-11

reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium only and no recycle). That is, the identified environmental impacts are based on the cycle that results in the greater impact.

The following assessment of the environmental impacts of the fuel cycle for two APWRs at VCS is based on the values in Table S-3 and the NRC's analysis of the radiological impacts from Rn-222 and Tc-99 in NUREG-1437. NUREG-1437 and Addendum 1 to the Generic Environmental Impact Statement (GEIS) for License Renewal (U.S. NRC Aug 1999) provide a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to impacts related to license renewal, the information is relevant to this review because the LWR designs considered here use the same type of fuel.

The fuel cycle impacts in Table S-3 are based on a reference 1000 MWe LWR operating at an annual capacity factor of 80 percent for an average electrical output of 800 MWe. The evaluation of the environmental impacts of the fuel cycle for the APWR, assumed a 1700 MWe (gross) reactor with a capacity factor of 96.3 percent for an average electrical output of 1637 MWe per unit. Two APWR units are proposed for VCS for a total of 3274 MWe. The proposed VCS output is approximately 4.1 times greater than the output used to estimate impact values in Table S-3 (reproduced here as the first column of Table 5.7-1) for the reference reactor. Analyses presented here are scaled from the reference reactor impacts to reflect the output of two APWRs at VCS.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as described below, the contemporary fuel cycle impacts are bounded by values in Table S-3. The NRC calculated the values in Table S-3 from industry averages for the performance of each type of facility or operation associated with the fuel cycle. They chose assumptions so that the calculated values will not be underestimated. This approach was intended to ensure that the actual values will be less than the quantities shown in Table S-3 for all LWR nuclear power plants within the widest range of operating conditions. Changes in the fuel cycle and reactor operations have occurred since Table S-3 was promulgated. For example, the estimated quantity of fuel required for a year's operation of a nuclear power plant can now reasonably be calculated assuming a 60-year lifetime (40 years of initial operation plus a 20-year license renewal term). This was done in NUREG-1437 for both BWRs and PWRs, and the highest annual requirement (35 metric tons of uranium [MTU] made into fuel for a BWR) was used in NUREG-1437 as the basis for the reference reactor year. A number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and enrichment requirements, reducing annual fuel requirements. An APWR requires approximately ~~46~~ 35 MTUs per year, approximately ~~31 percent more than~~ the same as the BWR refueling requirement evaluated in NUREG-1437, but its electrical output is more than 100 percent greater than the reference reactor. Therefore, Table S-3 remains a conservative be a 1300 MWe (net) reactor[2] with a 95 percent capacity factor. The ESBWR is assumed to be a 1535 MWe (net) reactor with a 96 percent capacity factor. The AP1000 is assumed to be a 1117 MWe (net) reactor with a 93 percent capacity factor. The APWR is assumed to be a 1600 MWe (net) reactor with a 96.3 percent factor. The standard configuration (a single unit) for each of the LWR technologies will be used to evaluate transportation impacts relative to the reference reactor.

Subparagraph 10 CFR 51.52(a)(1) through (5) delineate specific conditions the reactor licensee must meet to use Table S-4 as part of its environmental report. For reactors not meeting all of the conditions in paragraph (a) of 10 CFR 51.52, paragraph (b) of 10 CFR 51.52 requires a further analysis of the transportation effects.

The conditions in paragraph (a) of 10 CFR 51.52 establishing the applicability of Table S-4 are reactor core thermal power, fuel form, fuel enrichment, fuel encapsulation, average fuel irradiation, time after discharge of irradiated fuel before shipment, mode of transport for unirradiated fuel, mode of transport for irradiated fuel, radioactive waste form and packaging, and mode of transport for radioactive waste other than irradiated fuel. The following sections describe the characteristics of the LWR technologies relative to the conditions of 10 CFR 51.52 for use of Table S-4.

Reactor core thermal power

Subparagraph 10 CFR 51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3800 MWt. The ABWR has a rated thermal power level of 3926 MWt that exceeds this condition. The ESBWR has a rated thermal power of 4500 MWt that exceeds this condition. The AP1000 has a rated thermal power of 3415 MWt that meets this condition. The APWR has a rated thermal power of 4451 MWt that exceeds this condition.

The core power level was established as a condition because, for the LWRs being licensed when Table S-4 was promulgated, higher power levels indicated the need for more fuel and therefore more fuel shipments. This is not the case for the new LWR designs due to the higher unit capacity factor and higher burnup for these reactors. The annual fuel reloading for the reference reactor analyzed in WASH-1238 was 30 MTU. The annual fuel loading for the ABWR is approximately 30 MTU. When normalized to equivalent electric output, the annual fuel requirement for the ABWR is approximately 21 MTU or 72 percent that of the reference LWR.

The annual fuel loading for the ESBWR is approximately 38.5 MTU. When normalized to equivalent electric output, the annual fuel requirement for the ESBWR is approximately 23 MTU or 77 percent that of the reference LWR.

2. Net electrical output for ~~the ABWR~~all of the reactors evaluated was used to provide conservatism in the estimates of normalized transportation impacts for comparison with the reference reactor and Table S-4.

The annual fuel loading for the AP1000 is approximately 23 MTU. When normalized to equivalent electric output, the annual fuel requirement for the AP1000 is approximately 19.5 MTU or 65 percent that of the reference LWR.

The annual fuel loading for the APWR is approximately ~~46.4~~34.8 MTU. When normalized to equivalent electric output, the annual fuel requirement for the APWR is approximately ~~26.5~~19.9 MTU or ~~88~~66 percent that of the reference LWR.

WASH-1238 states:

> The analysis is based on shipments of fresh fuel to and irradiated fuel and solid waste from a boiling water reactor or a pressurized water reactor with design ratings of 3000 MWt to 5000 MWt or 1000 MWe to 1500 MWe.

The ABWR and AP1000 fall within these bounds for thermal and electrical rating. The ESBWR and APWR deviate slightly from the maximum listed electrical output due to a slightly higher thermal efficiency. The higher thermal efficiency has no impact on the analysis.

Fuel form

Subparagraph 10 CFR 51.52(a)(2) requires that the reactor fuel be in the form of sintered uranium dioxide (UO2) pellets. All of the LWR technologies use a sintered UO2 pellet fuel form.

Fuel enrichment

Subparagraph 10 CFR 51.52(a)(2) requires that the reactor fuel have a U-235 enrichment not exceeding 4 percent by weight. For the ABWR, the enrichment of the initial core averages approximately 2.22 percent and the average for the reloads is approximately 3.2 percent. The ABWR fuel meets the 4 percent U-235 enrichment condition.

For the ESBWR, the enrichment of the initial core averages approximately 2.08 percent and the average for the reloads ranges from 4.02 to 4.12 percent. The ESBWR fuel exceeds the 4 percent U-235 enrichment condition.

For the AP1000, the enrichment of the initial core varies by region from 2.35 to 4.45 percent. The AP1000 fuel exceeds the 4 percent U-235 condition.

For the APWR, the maximum fuel enrichment is less than 5 percent and the initial core varies by region from 2.05 to 4.15 percent. The APWR fuel exceeds the 4 percent U-235 condition.

initial core assuming 0.174 MTU per fuel assembly) and 173 fuel assemblies per year for refueling. General Electric Nuclear Energy estimates that a transportation container could accommodate up to 28 fuel assemblies.

For the ESBWR, the initial core load is estimated at 185 MTU per unit and the reload requirements are estimated at 38.5 MTU per year per unit. This equates to approximately 1132 fuel assemblies in the initial core assuming 0.163 MTU per fuel assembly and 236 fuel assemblies per year for refueling. General Electric-Hitachi Nuclear Energy estimates that a transportation container could accommodate up to 28 fuel assemblies.

For the AP1000, the initial core load is estimated at 84.5 MTU per unit and the reload requirements are estimated at 23 MTU per year per unit. This equates to approximately 157 fuel assemblies in the initial core (assuming 0.5383 MTU per fuel assembly) and 43 fuel assemblies per year for refueling. Westinghouse estimates that a transportation container could accommodate up to 7 fuel assemblies for the initial core load and 9 fuel assemblies for core reloads.

For the APWR, the initial core load is estimated at 139 MTU per unit and the reload requirements are estimated at ~~46~~ 34.8 MTU per year per unit. This equates to approximately 257 fuel assemblies in the initial core (assuming ~~0.6124~~0.5398 MTU per fuel assembly) and 65 fuel assemblies per year for refueling. Mitsubishi Heavy Industries estimates that a transportation container could accommodate up to 12 fuel assemblies.

The numbers of spent fuel shipments were estimated as follows. For the reference LWR analyzed in WASH-1238, the NRC assumed that 60 shipments per year will be made, each carrying 0.5 MTU of spent fuel. This amount is equivalent to the annual refueling requirement of 30 MTU per year for the reference LWR. For this transportation analysis, shipments of spent fuel from the VCS site were assumed to occur at a rate equal to the annual refueling requirement. The shipping cask capacities used to calculate annual spent fuel shipments were assumed to be the same as those for the reference LWR (0.5 MTU per legal weight truck shipment). This results in 61 shipments per year for one ABWR, 78 shipments per year for one ESBWR, 46 shipments per year for one AP1000, and ~~93~~70 shipments per year per one APWR. After normalizing for electrical output, the number of spent fuel shipments is 43 per year for the ABWR, 47 per year for the ESBWR, 39 per year for the AP1000, and ~~54~~40 per year for the APWR. The normalized spent fuel shipments for each of the LWR technologies would be less than the reference reactor that was the basis for Table S-4.

Table 5.7-4 presents estimates of annual waste volumes and numbers of truck shipments. The values are normalized to the reference LWR analyzed in WASH-1238. Based on the expected shipped waste volumes provided in the AP1000 DCD, the normalized annual waste volumes and waste shipments for the AP1000 will be less than the reference reactor that was the basis for Table S-4. However, the AP1000 waste estimates include onsite processing that would reduce the waste volume by a factor of three. For this analysis, it is conservatively assumed that Exelon would not perform onsite volume reduction. The dry active waste would be packaged and shipped to offsite processors. When this is factored into the waste estimates for the LWR technologies, the waste volumes and numbers of waste shipments are higher relative to the reference LWR.

The normalized total numbers of truck shipments of fuel and radioactive waste are estimated to be 193 per year for the ABWR, 168 per year for the ESBWR, 64 per year for the AP1000, and ~~165~~150 per year for the APWR. Thus, these radioactive material shipment estimates are well below the one truck shipment per day condition given in 10 CFR 51.52, Table S-4.

Summary

Table 5.7-5 compares the values for the reference conditions in paragraph (a) of 10 CFR 51.52 used in Table S-4 and the values for the LWR technologies. The ABWR does not meet the condition for rated thermal power. The ESBWR and APWR do not meet the conditions for rated thermal power, fuel enrichment, or average fuel irradiation. The AP1000 does not meet the conditions for fuel enrichment or average fuel irradiation. Therefore, Subsection 5.7.2.2 and Section 7.4 will present additional analyses of fuel transportation effects for normal conditions and accidents, respectively.

5.7.2.2 **Incident-Free Transportation Impacts Analysis**

The environmental impacts of radioactive materials transportation were estimated using the most recent version of the RADTRAN 5 computer code (Weiner et al. Apr 2008). RADTRAN is a nationally accepted standard program and code for calculating the risks of transporting radioactive materials. RADTRAN was used in estimating the radiological doses and dose risks to populations and transportation workers resulting from incident-free transportation and to the general population from accident scenarios. For the analysis of incident-free transportation risks, the code used scenarios for persons who would share transportation routes with shipments, persons who live along the route of travel, and persons exposed at stops. For accident risks, RADTRAN was used to evaluate the range of possible accident scenarios from high probability and low consequence to low probability and high consequence. Environmental impacts of incident-free transportation of fuel are described in this section. Transportation accidents are described in Section 7.4.

5.7.2.2.1 **Transportation of Unirradiated Fuel**

Table S-4 of 10 CFR 51.52 includes conditions related to radiological doses to transport workers and members of the public along transport routes. These doses, based on calculations in WASH-1238, are a function of the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time of transit (including travel and stop times), and the number of shipments to which the individuals are exposed.

Table 5.7-3
Number of Truck Shipments of Unirradiated Fuel

Reactor Type	Number of Shipments per Unit: Initial Core[(a)]	Number of Shipments per Unit: Annual Reload	Number of Shipments per Unit: Total[(b)]	Unit Electric Generation, MW(e)[(c)]	Capacity Factor	Normalized Shipments Total[(d)]	Normalized Shipments Annual[(e)]
Reference LWR	18[(f)]	6.0	252	1100	0.8	252	6.3
ABWR	32	6.2	273	1300	0.95	195	4.9
ESBWR	41	8.4	370	1535	0.96	221	5.5
AP1000	23	4.7	203	1117	0.93	172	4.3
APWR	22	5.4	~~301~~231	1600	0.963	~~172~~132	~~4.3~~3.3

(a) Shipments of the initial core have been rounded up to the next highest whole number.

(b) Total shipments of fresh fuel over 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).

(c) ABWR unit net generating capacity from GE (Mar 1997), ESBWR unit generating capacity from GEH (Aug 2007), AP1000 unit generating capacity from WEC (Sep 2008), and APWR generating capacity from MHI (Aug 2008).

(d) Normalized to electric output for WASH-1238 reference plant (i.e., 1100 MWe plant at 80 percent or an electrical output of 880 MWe).

(e) Annual average for 40-year plant lifetime.

(f) The initial core load for the reference BWR in WASH-1238 was 150 MTU. The initial core load for the reference PWR was 100 MTU. Both types result in 18 truck shipments of fresh fuel per reactor.

Table 5.7-5 (Sheet 1 of 2)
Reactor Design Comparisons to Table S-4 Reference Conditions

Characteristic	Table S-4 Condition	ABWR	ESBWR	AP1000	APWR
Thermal Power Rating (MWt)	not exceeding 3800 per reactor	3926	4500	3415	4451
Fuel Form	sintered UO_2 pellets	sintered UO_2 pellets	sintered UO_2 pellets	sintered UO_2 pellets	sintered UO_2 pellets
U-235 Enrichment (percent)	Not exceeding 4	Initial Core Average 2.22; Reload Average 3.2	Initial Core Average 2.08; Reload Average 4.02 to 4.12	Initial Core: Region 1 — 2.35 Region 2 — 3.40 Region 3 — 4.45	Initial Core: Region 1 — 2.05 Region 2 — 3.55 Region 3 — 4.15
Fuel Rod Cladding	Zircaloy rods; NRC has also accepted ZIRLO™ per 10 CFR 50.46	Zircaloy	Zircaloy	ZIRLO™	ZIRLO™
Average fuel irradiation (MWd per MTU)	Not exceeding 33,000	32,300	42,000 to 46,000	50,533	46,000
Unirradiated Fuel					
Transport Mode	truck	truck	truck	truck	truck
No. of shipments for initial core loading		32	41	23	22
(normalized number)		(23)[(a)]	25)[a]	(19)[a]	(13)[a]
No. of reload shipments per year		6.2	8.4	4.7	5.4
(normalized number)		(4.4)[a]	(5.0)[a]	(4.0)[a]	(3.1)[a]
Irradiated Fuel					
Transport mode	truck, rail or barge	truck, rail	truck, rail	truck, rail	truck, rail
Decay time before shipment	minimum of 5 years	minimum of 5 years	minimum of 5 years	minimum of 5 years	minimum of 5 years
No. of spent fuel shipments by truck		61 per year	78 per year	46 per year	~~93~~70 per year
(normalized number)		(43 per year)	(47 per year)	(39 per year)	(~~54~~40 per year)
No. of spent fuel shipments by rail		not analyzed	not analyzed	not analyzed	not analyzed
Radioactive Waste					
Transport mode	truck or rail	truck	truck	truck	truck

Table 5.7-6
RADTRAN 5 Input Parameters for Analysis of Unirradiated Fuel Shipments

Parameter	RADTRAN 5 Input Value
Shipping distance, miles[a]	2000
Travel Fraction – Rural	0.90
Travel Fraction – Suburban	0.05
Travel Fraction – Urban	0.05
Population Density – Rural, persons per sq. mi	25.9
Population Density – Suburban, persons per sq. mi	904
Population Density – Urban, persons per sq. mi	5850
Vehicle speed, miles per hr.	55
Traffic count – Rural, vehicles per hr.	530
Traffic count – Suburban, vehicles per hr.	760
Traffic count – Urban, vehicles per hr.	2400
Dose rate at 1 meter from vehicle, mrem per hr.	0.1
Packaging length, ft	24
Number of truck crew	2
Stop time, hr. per trip	4.0
Population density at stops, persons per sq. mi	77,700
Population density surrounding truck stops, persons per sq. mi	881

(a) WASH-1238 had a range of shipping distances between 25 and 3000 miles for unirradiated fuel shipments. A 2000-mile "average" shipping distance was used for this analysis consistent with the assumptions in NRC analyses of ESP sites.

Table 5.7-7
Radiological Impacts of Transporting Unirradiated Fuel to the Site by Truck

		Cumulative Annual Dose, person-rem per reference reactor year		
Reactor Type	Normalized Average Annual Shipments	Transport Workers	General Public - onlookers	General Public - along route
Reference LWR	6.3	0.011	0.018	1.9×10^{-4}
ABWR	4.9	0.0083	0.014	1.5×10^{-4}
ESBWR	5.5	0.0094	0.016	1.7×10^{-4}
AP1000	4.3	0.0073	0.013	1.3×10^{-4}
APWR	~~4.3~~3.3	0.00~~73~~56	~~0.013~~0.0096	~~1.3×10^{-4}~~9.9×10^{-5}
10 CFR 51.52 Table S-4 condition[a]	365 (<1 per day)	4	3	3

(a) Table S-4 conditions apply to all types of radioactive material transportation. The impacts of unirradiated fuel shipments constitute a small fraction of the overall cumulative annual dose limit.

Table 5.7-10
Population Doses from Spent Fuel Transportation, Normalized to Reference LWR

Exposed Population	Cumulative dose limit specified in Table S-4, person-rem per reactor year	Reactor Type				
		Reference LWR	ABWR	ESBWR	AP1000	APWR
		Normalized Number of Spent Fuel Shipments per year				
		60	43	47	39	~~54~~40
		Environmental Effects, person-rem per reactor year				
Crew	4	8.0	5.7	6.3	5.2	~~7.2~~5.3
Onlookers	3	14	10	11	9.2	~~13~~9.5
Along route	3	0.33	0.24	0.26	0.21	~~0.30~~0.22

Massive shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance features required by 10 CFR 71, "Packaging and Transportation of Radioactive Material." Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe hypothetical accident conditions with essentially no loss of containment or shielding capability[1]. As stated in NUREG/CR-6672 (Sprung et al. Mar 2000), the probability of encountering accident conditions that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). This analysis assumed that shipping casks for the advanced LWR spent fuel would provide equivalent mechanical and thermal protection of the spent fuel cargo, in accordance with the requirements of 10 CFR 71.

The RADTRAN 5 accident risk calculations were performed using an assumption of 0.5 metric tons of uranium (MTU) per shipment for radionuclide inventories. The resulting risk estimates were multiplied by the expected annual spent fuel shipment amounts (in MTU per year) to derive estimates of the annual accident risks associated with the advanced LWR spent fuel shipments. The amount of spent fuel shipped per year was assumed to be equivalent to the annual discharge quantity: 30 MTU per year for the ABWR, 38.5 MTU per year for the ESBWR, 23 MTU per year for the AP1000, and ~~46~~34.8 MTU per year for the APWR. (This discharge quantity has not been normalized to the reference LWR. The normalized value is presented in Table 7.4-2.)

The release fractions for current generation LWR fuels were used to approximate the impacts from the advanced LWR spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding and fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions.

Using RADTRAN 5, the population dose from the released radioactive material was calculated for five possible exposure pathways:

- External dose from exposure to the passing cloud of radioactive material.
- External dose from the radionuclides deposited on the ground by the passing plume (the radiation exposure from this pathway was included even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway).
- Internal dose from inhalation of airborne radioactive contaminants.

1. Requirements for Type B packaging are set forth in 49 CFR § 173.413 and 10 CFR §§ 71.41 through 47 and § 71.51.

Table 7.4-1
Radionuclide Inventory Used in Transportation Accident Risk Calculations

Radionuclide	ABWR Inventory (curies per MTU)	ESBWR Inventory (curies per MTU)	AP1000 Inventory (curies per MTU)	APWR Inventory (curies per MTU)
Am-241	1.44×10^3	1.30×10^3	7.27×10^2	~~9.77×10^2~~ 1.81×10^3
Am-242m	3.32×10^1	2.79×10^1	1.31×10^1	~~1.10×10^1~~ 2.04×10^1
Am-243	5.95×10^1	3.26×10^1	3.34×10^1	~~4.02×10^1~~ 7.45×10^1
Ce-144	1.32×10^4	1.35×10^4	8.87×10^3	~~7.40×10^3~~ 1.39×10^4
Cm-242	6.22×10^1	4.86×10^1	2.83×10^1	~~3.28×10^1~~ 6.08×10^1
Cm-243	6.17×10^1	3.47×10^1	3.07×10^1	~~3.11×10^1~~ 5.76×10^1
Cm-244	1.35×10^4	4.96×10^3	7.75×10^3	~~6.77×10^3~~ 1.25×10^4
Cm-245	2.25	6.75×10^{-1}	1.21	–
Co-60	3.63×10^3	2.86×10^3	4.09	~~4.63×10^1~~ 8.58×10^1
Cs-134	7.76×10^4	5.19×10^4	4.80×10^4	~~3.46×10^4~~ 6.41×10^4
Cs-137	1.58×10^5	1.27×10^5	9.31×10^4	~~9.50×10^4~~ 1.76×10^5
Eu-154	1.56×10^4	1.05×10^4	9.13×10^3	~~5.56×10^3~~ 1.03×10^4
Eu-155	8.27×10^3	5.47×10^3	4.62×10^3	~~1.48×10^3~~ 2.74×10^3
Pm-147	3.13×10^4	3.53×10^4	1.76×10^4	~~2.79×10^4~~ 5.17×10^4
Pu-238	1.09×10^4	6.15×10^3	6.07×10^3	~~5.13×10^3~~ 9.50×10^3
Np-239	–	–	–	~~4.02×10^1~~ 7.45×10^1
Pu-239	4.27×10^2	3.86×10^2	2.55×10^2	~~2.20×10^2~~ 4.08×10^2
Pu-240	8.52×10^2	6.22×10^2	5.43×10^2	~~3.76×10^2~~ 6.97×10^2
Pu-241	1.35×10^5	1.22×10^5	6.96×10^4	~~9.07×10^4~~ 1.68×10^5
Pu-242	3.19	2.24	1.82	–
Ru-106	2.29×10^4	1.86×10^4	1.55×10^4	~~1.33×10^4~~ 2.46×10^4

Table 7.4-1
Radionuclide Inventory Used in Transportation Accident Risk Calculations

Sb-125	7.17×10^3	5.80×10^3	3.83×10^3	~~1.83×10^3~~ 3.39×10^3
Sr-90	1.06×10^5	9.08×10^4	6.19×10^4	~~6.46×10^4~~ 1.20×10^5
Y-90	1.06×10^5	9.09×10^4	6.19×10^4	~~6.46×10^4~~ 1.20×10^5

Table 7.4-2
Spent Fuel Transportation Accident Risks

Site	Victoria County	Matagorda County	Buckeye	Alpha	Bravo
ABWR					
Unit Population Dose (person-rem per MTU)[(a)]	2.78×10^{-7}	2.60×10^{-7}	2.60×10^{-7}	2.58×10^{-7}	2.92×10^{-7}
MTU per Reference Reactor Year	21.5	21.5	21.5	21.5	21.5
Population Dose (person-rem per reference reactor year)[(a)]	5.97×10^{-6}	5.59×10^{-6}	5.59×10^{-6}	5.54×10^{-6}	6.27×10^{-6}
Total Detrimental Health Effects per Reference Reactor Year	4.36×10^{-9}	4.08×10^{-9}	4.08×10^{-9}	4.05×10^{-9}	4.58×10^{-9}
ESBWR					
Unit Population Dose (person-rem per MTU)[(a)]	1.03×10^{-7}	9.70×10^{-8}	9.70×10^{-8}	9.62×10^{-8}	1.09×10^{-7}
MTU per Reference Reactor Year	23.0	23.0	23.0	23.0	23.0
Population Dose (person-rem per reference reactor year)[(a)]	2.38×10^{-6}	2.23×10^{-6}	2.23×10^{-6}	2.21×10^{-6}	2.50×10^{-6}
Total Detrimental Health Effects per Reference Reactor Year	1.73×10^{-9}	1.63×10^{-9}	1.63×10^{-9}	1.62×10^{-9}	1.82×10^{-9}
AP1000					
Unit Population Dose (person-rem per MTU)[(a)]	3.62×10^{-8}	3.40×10^{-8}	3.40×10^{-8}	3.38×10^{-8}	3.82×10^{-8}
MTU per Reference Reactor Year	19.5	19.5	19.5	19.5	19.5
Population Dose (person-rem per reference reactor year)[(a)]	7.04×10^{-7}	6.62×10^{-7}	6.62×10^{-7}	6.58×10^{-7}	7.43×10^{-7}
Total Detrimental Health Effects per Reference Reactor Year	5.14×10^{-10}	4.83×10^{-10}	4.83×10^{-10}	4.80×10^{-10}	5.43×10^{-10}
APWR					
Unit Population Dose (person-rem per MTU)[(a)]	6.34×10^{-8}	5.96×10^{-8}	5.96×10^{-8}	5.92×10^{-8}	6.68×10^{-8}
MTU per Reference Reactor Year	~~26.5~~19.9	~~26.5~~19.9	~~26.5~~19.9	~~26.5~~19.9	~~26.5~~19.9
Population Dose (person-rem per reference reactor year)[(a)]	~~1.68×10^{-6}~~1.26×10^{-6}	~~1.58×10^{-6}~~1.19×10^{-6}	~~1.58×10^{-6}~~1.19×10^{-6}	~~1.57×10^{-6}~~1.18×10^{-6}	~~1.77×10^{-6}~~1.33×10^{-6}
Total Detrimental Health Effects per Reference Reactor Year	~~1.23×10^{-9}~~9.20×10^{-10}	~~1.15×10^{-9}~~8.65×10^{-10}	~~1.15×10^{-9}~~8.65×10^{-10}	~~1.15×10^{-9}~~8.59×10^{-10}	~~1.29×10^{-9}~~9.70×10^{-10}

(a) Value presented is the product of probability multiplied by collective dose.

Table 7.4-3
Nonradiological Impacts of Transporting Unirradiated Fuel to the Victoria County Station

				Annual Impacts		
Reactor	**Total Shipments Normalized to Reference LWR**	**One-Way Shipping Distance (miles)**	**Total Round-trip Shipping Distance (miles)**	**Fatalities per Year**	**Injuries per Year**	**Accidents per Year**
Reference LWR	252	2000	1.01×10^{6}	3.7×10^{-4}	0.0078	0.011
ABWR	195	2000	7.80×10^{5}	2.9×10^{-4}	0.0060	0.0088
ESBWR	221	2000	8.84×10^{5}	3.3×10^{-4}	0.0069	0.010
AP1000	172	2000	6.88×10^{5}	2.5×10^{-4}	0.0053	0.0078
APWR	~~172~~132	2000	~~6.88~~5.28 × 10^{5}	~~2.5~~2.0 × 10^{-4}	0.00~~53~~41	0.00~~78~~60

Table 7.4-4 (Sheet 2 of 2)
Nonradiological Impacts of Transporting Spent Fuel from the Victoria County Station

State	Highway Type	One-Way Shipping Distance (miles)	Fatalities per Year	Injuries per Year	Accidents per Year
APWR					
Arizona	Interstate	391	~~6.4~~4.7 × 10^{-4}	~~0.0080~~0.0059	~~0.0090~~0.0066
California	Interstate	367	~~4.5~~3.3 × 10^{-4}	~~0.0079~~0.0059	~~0.010~~0.0076
Nevada	Interstate	66	~~7,5~~5.6× 10^{-5}	~~0.0017~~0.0013	~~0.0026~~0.0019
	Primary	79	~~2.3~~1.7 × 10^{-4}	~~0.0035~~0.0026	~~0.0052~~0.0039
New Mexico	Interstate	164	~~3.4~~2.5 × 10^{-4}	~~0.0033~~0.0024	~~0.0032~~0.0024
Texas	Interstate	670	~~0.0015~~0.0011	~~0.064~~0.047	~~0.076~~0.052
	Primary	71	~~3.5~~2.6 × 10^{-4}	~~0.0065~~0.0048	~~0.0086~~0.0063
Totals	–	1,807	~~0.0036~~0.0027	~~0.094~~0.070	~~0.11~~0.080

ENCLOSURE 2

SUMMARY OF REGULATORY COMMITMENTS

(Exelon Letter to USNRC No. NP-10-0009, dated May 27, 2010)

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
Exelon will revise the ESPA Environmental Report Sections 5.7.2 and 7.4 to incorporate the changes shown in Enclosure 1 to correct the APWR values for the potential number of shipments, collective dose, radiological accident risks, and numbers of accidents/fatalities due to transportation accidents; and to correct the APWR radionuclide inventory units/values.	Revision 1 of the ESPA Environmental Report planned for March 25, 2011	Yes	No