Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
SRS	No change	No change	No change	None	Dose Public: 2.9×10^{-4} Workers: 7.5 LCFs Public: 7.2×10^{-6} Workers: 0.15	NA	None
LLNL	No change	No change	No change	None	Dose Public: 6.7×10^{-3} Workers: 25 LCFs Public: 1.7×10^{-4} Workers: 0.50	NA	None
LANL	No change	No change	No change	None	Dose Public: 2.7 Workers: 12.5 LCFs Public: 6.8×10^{-2} Workers: 0.25	NA	None
RFETS	No change	No change	No change	None	Dose Public: 0.10 Workers: 25 LCFs Public: 2.5×10^{-3} Workers: 0.50	NA	None

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford							
Hanford	CO: 0.651 NO_2: 0.0873 PM_{10}: 0.00541 SO_2: 0.00496	TRU: 1,800 LLW: 2,300 MLLW: 50 Haz: 800	Construction: 1,235 Operations: 1,165	22	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.2 Workers: 488 LCFs Public: 3.6×10^{-2} Workers: 2.0	Tritium release at pit conversion facility: 0.11 LCF	LCFs: 6.1×10^{-2} Traffic fatalities: 7.4×10^{-2} Kilometers traveled: 7.5M Additional risk of LCFs at Pantex: 8.3×10^{-2}

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 3: Pit Conversion, Immobilization, and MOX in New Construction at SRS							
SRS	CO: 0.37 NO_2: 0.0634 PM_{10}: 0.00423 SO_2: 0.124	TRU: 1,800 LLW: 2,400 MLLW: 50 Haz: 940	Construction: 1,968 Operations: 1,120	32 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 4.1 LCFs: 1.6×10^{-3} Operations Dose Public: 1.8 Workers: 456 LCFs Public: 9.0×10^{-3} Workers: 1.8	Tritium release at pit conversion facility: 5.0×10^{-2} LCF	LCFs: 8.1×10^{-2} Traffic fatalities: 5.3×10^{-2} Kilometers traveled: 4.3M Additonal risk of LCFs at Pantex: 8.3×10^{-2}
[Text deleted because alternative deleted.][h]							

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10 Haz: 20	Construction: 451 Operations: 400	5.0	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 5.7×10^{-2} Traffic fatalities: 6.5×10^{-2} Kilometers traveled: 6.3M Additional risk of LCFs at Pantex: 0
Hanford	CO: 0.374 NO_2: 0.052 PM_{10}: 0.00367 SO_2: 0.00343	TRU: 1,600 LLW: 1,700 MLLW: 40 Haz: 780	Construction: 1,148 Operations: 720	16	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.30 Workers: 264 LCFs Public: 1.5×10^{-3} Workers: 1.1	Nuclear criticality at MOX facility: 1.9×10^{-2} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10 Haz: 20	Construction: 451 Operations: 400	5.0	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 5.7×10^{-2} Traffic fatalities: 6.5×10^{-2} Kilometers traveled: 6.3M Additional risk of LCFs at Pantex: 0
Hanford	CO: 0.507 NO_2: 0.0707 PM_{10}: 0.00499 SO_2: 0.00468	TRU: 1,600 LLW: 1,700 MLLW: 40 Haz: 780	Construction: 1,064 Operations: 765	17.4	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.15 Workers: 296 LCFs Public: 7.3×10^{-4} Workers: 1.2	Nuclear criticality at MOX or immobilization facility: 1.9×10^{-2} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 5: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10 Haz: 20	Construction: 451 Operations: 400	5.0	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 7.7×10^{-2} Traffic fatalities: 5.0×10^{-2} Kilometers traveled: 3.8M Additional risk of LCFs at Pantex: 0
SRS	CO: 0.275 NO_2: 0.0347 PM_{10}: 0.0024 SO_2: 0.0829	TRU: 1,600 LLW: 1,800 MLLW: 40 Haz: 920	Construction: 1,692 Operations: 720	27 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 2.7 LCFs: 1.1×10^{-3} Operations Dose Public: 1.8×10^{-2} Workers: 264 LCFs Public: 9.2×10^{-4} Workers: 1.1	Nuclear criticality at MOX facility: 8.0×10^{-3} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS							
Hanford	CO: 0.247 NO_2: 0.031 PM_{10}: 0.00143 SO_2: 0.00123	TRU: 860 LLW: 1,500 MLLW: 40 Haz: 50	Construction: 844 Operations: 785	14	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.2 Workers: 214 LCFs Public: 3.6×10^{-2} Workers: 0.86	Tritium release at pit conversion facility: 0.11 LCF	LCFs: 9.6×10^{-2} Traffic fatalities: 9.1×10^{-2} Kilometers traveled: 8.6M Additional risk of LCFs at Pantex: 8.3×10^{-2}
SRS	CO: 0.152 NO_2: 0.0242 PM_{10}: 0.00181 SO_2: 0.0442	TRU: 950 LLW: 810 MLLW: 10 Haz: 890	Construction: 1,014 Operations: 335	15 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 1.5 LCFs: 6.0×10^{-4} Operations Dose Public: 2.8×10^{-3} Workers: 242 LCFs Public: 1.4×10^{-5} Workers: 0.97	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS							
Hanford	CO: 0.247 NO_2: 0.031 PM_{10}: 0.00143 SO_2: 0.00123	TRU: 860 LLW: 1,500 MLLW: 40 Haz: 50	Construction: 655 Operations: 785	14	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.0 Workers: 214 LCFs Public: 3.5×10^{-2} Workers: 0.86	Tritium release at pit conversion facility: 0.11 LCF	LCFs: 9.6×10^{-2} Traffic fatalities: 9.1×10^{-2} Kilometers traveled: 8.6M Additional risk of LCFs at Pantex: 8.3×10^{-2}
SRS	CO: 0.152 NO_2: 0.0242 PM_{10}: 0.00181 SO_2: 0.0442	TRU: 950 LLW: 810 MLLW: 10 Haz: 890	Construction: 1,014 Operations: 335	15 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 1.5 LCFs: 6.0×10^{-4} Operations Dose Public: 2.8×10^{-3} Workers: 242 LCFs Public: 1.4×10^{-5} Workers: 0.97	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 7: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS							
INEEL	CO: 0.762 NO_2: 0.144 PM_{10}: 0.00833 SO_2: 0.345	TRU: 860 LLW: 1,500 MLLW: 40 Haz: 50	Construction: 866 Operations: 743	14	Construction (workforce) Dose: 2.0 LCFs: 7.7×10^{-4} Operations Dose Public: 2.2 Workers: 192 LCFs Public: 1.1×10^{-2} Workers: 0.77	Tritium release at pit conversion facility: 4.4×10^{-3} LCF	LCFs: 9.4×10^{-2} Traffic fatalities: 8.3×10^{-2} Kilometers traveled: 7.5M Additional risks of LCFs at Pantex: 8.3×10^{-2}
SRS	CO: 0.152 NO_2: 0.0242 PM_{10}: 0.00181 SO_2: 0.0442	TRU: 950 LLW: 810 MLLW: 10 Haz: 890	Construction: 1,014 Operations: 335	15 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 1.5 LCFs: 6.0×10^{-4} Operations Dose Public: 2.8×10^{-3} Workers: 242 LCFs Public: 1.4×10^{-5} Workers: 0.97	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford							
INEEL	CO: 0.762 NO_2: 0.144 PM_{10}: 0.00833 SO_2: 0.345	TRU: 860 LLW: 1,500 MLLW: 40 Haz: 50	Construction: 866 Operations: 743	14	Construction (workforce) Dose: 2.0 LCFs: 7.7×10^{-4} Operations Dose Public: 2.2 Workers: 192 LCFs Public: 1.1×10^{-2} Workers: 0.77	Tritium release at pit conversion facility: 4.4×10^{-3} LCF	LCFs: 5.9×10^{-2} Traffic fatalities: 6.5×10^{-2} Kilometers traveled: 6.3M Additional risks of LCFs at Pantex: 8.3×10^{-2}
Hanford	CO: 0.271 NO_2: 0.0376 PM_{10}: 0.00265 SO_2: 0.00249	TRU: 950 LLW: 800 MLLW: 10 Haz: 750	Construction: 414 Operations: 335	4.5	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.8×10^{-3} Workers: 242 LCFs Public: 3.9×10^{-5} Workers: 0.97	Nuclear criticality at immobilization facility: 2.7×10^{-3} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 9: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS							
Pantex	CO: 0.705 NO_2: 0.0736 PM_{10}: 0.00531 SO_2: 0.00265	TRU: 860 LLW: 1,500 MLLW: 40 Haz: 50	Construction: 1,048 Operations: 785	17	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.61 Workers: 214 LCFs Public: 3.0×10^{-3} Workers: 0.86	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 8.1×10^{-2} Traffic fatalities: 5.2×10^{-2} Kilometers traveled: 4.8M Additional risk of LCFs at Pantex: 0
SRS	CO: 0.152 NO_2: 0.0242 PM_{10}: 0.00181 SO_2: 0.0442	TRU: 950 LLW: 810 MLLW: 10 Haz: 890	Construction: 1,014 Operations: 335	15 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 1.5 LCFs: 6.0×10^{-4} Operations Dose Public: 2.8×10^{-3} Workers: 242 LCFs Public: 1.4×10^{-5} Workers: 0.97	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 10: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford							
Pantex	CO: 0.705 NO_2: 0.0736 PM_{10}: 0.00531 SO_2: 0.00265	TRU: 860 LLW: 1,500 MLLW: 40 Haz: 50	Construction: 1,048 Operations: 785	17	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.61 Workers: 214 LCFs Public: 3.0×10^{-3} Workers: 0.86	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 4.6×10^{-2} Traffic fatalities: 4.3×10^{-2} Kilometers traveled: 3.6M Additional risk of LCFs at Pantex: 0
Hanford	CO: 0.271 NO_2: 0.0376 PM_{10}: 0.00265 SO_2: 0.00249	TRU: 950 LLW: 800 MLLW: 10 Haz: 750	Construction: 414 Operations: 335	4.5	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.8×10^{-3} Workers: 242 LCFs Public: 3.9×10^{-5} Workers: 0.97	Nuclear criticality at immobilization facility: 2.7×10^{-3} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford (No MOX)							
Hanford	CO: 0.548 NO_2: 0.0729 PM_{10}: 0.0044 SO_2: 0.00401	TRU: 1,400 LLW: 1,700 MLLW: 20 Haz: 770	Construction: 463 Operations: 812	11	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 6.9 Workers: 490 LCFs Public: 3.4×10^{-2} Workers: 2.0	Tritium release at pit conversion facility: 0.11 LCF	LCFs: 7.4×10^{-2} Traffic fatalities: 5.4×10^{-2} Kilometers traveled: 3.7M Additional risk of LCFs at Pantex: 8.3×10^{-2}

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 11B: Pit Conversion in New Construction at Pantex and Immobilization in FMEF and HLWVF at Hanford (No MOX)							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10 Haz: 20	Construction: 451 Operations: 400	5.0	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 7.07×10^{-2} Traffic fatalities: 4.5×10^{-2} Kilometers traveled: 2.5M Additional risk of LCFs at Pantex: 0
Hanford	CO: 0.271 NO_2: 0.0376 PM_{10}: 0.00265 SO_2: 0.00249	TRU: 1,300 LLW: 1,100 MLLW: 10 Haz: 750	Construction: 414 Operations: 367	4.5	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 1.6×10^{-2} Workers: 266 LCFs Public: 8.0×10^{-5} Workers: 1.1	Nuclear criticality at immobilization facility: 2.7×10^{-3} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS (No MOX)							
SRS	CO: 0.246 NO_2: 0.0529 PM_{10}: 0.00364 SO_2: 0.0852	TRU: 1,500 LLW: 1,700 MLLW: 20 Haz: 910	Construction: 1,196 Operations: 751	20 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 2.9 LCFs: 1.2×10^{-3} Operations Dose Public: 1.6 Workers: 446 LCFs Public: 8.0×10^{-3} Workers: 1.8	Tritium release at pit conversion facility: 5.0×10^{-2} LCF	LCFs: 0.152 Traffic fatalities: 8.1×10^{-2} Kilometers traveled: 4.4M Additional risk of LCFs at Pantex: 8.3×10^{-2}

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Site	Air Quality[a] (incremental pollutant concentrations in g/m^3)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS (No MOX)							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10 Haz: 20	Construction: 451 Operations: 400	5.0	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.8×10^{-2} LCF	LCFs: 0.148 Traffic fatalities: 7.8×10^{-2} Kilometers traveled: 3.9M Additional risk of LCFs at Pantex: 0
SRS	CO: 0.152 NO_2: 0.0242 PM_{10}: 0.00181 SO_2: 0.0442	TRU: 1,300 LLW: 1,100 MLLW: 10 Haz: 890	Construction: 1,014 Operations: 351	15 Disturbance could impact a site potentially eligible for the National Register of Historic Places	Construction (workforce) Dose: 1.5 LCFs: 6.0×10^{-4} Operations Dose Public: 5.8×10^{-3} Workers: 254 LCFs Public: 2.9×10^{-5} Workers: 1.0	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCF	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

[a] Values represent the incremental criteria pollutant concentrations associated with surplus plutonium disposition operations for the annual averaging period for nitrogen dioxide (NO_2), particulate matter with an aerodynamic diameter smaller than or equal to 10 microns (PM_{10}), and sulfur dioxide (SO_2), and for the 8-hour averaging period for carbon monoxide.

[b] Values are based on a construction period of approximately 3 years and 10 years of operation.

[c] Values are for the peak year of construction for each site and for the annual operation of all facilities for each alternative. Personnel needed to operate the planned HLW vitrification facility at Hanford, or DWPF at SRS, are not included.

[d] Values represent the total land disturbance at each site from construction and operations.

[e] Values for Alternative 1 represent impacts over 50 years of operation under No Action. Those for the remaining alternatives are for the period of construction and 10 years of operation. Public dose values represent the annual radiological dose (in person-rem) to the population within 80 km (50 mi) of the facility location for the year 2030 under Alternative 1, or for 2010 under Alternatives 2 through 12. Worker dose values represent the total radiological dose to involved workers at the facility (in person-rem/year). Public LCFs represent the 50-year LCFs estimated to occur in the population within 80 km (50 mi) for the year 2030 under Alternative 1, or the 10-year LCFs estimated to occur for the year 2010 under Alternatives 2 through 12. Worker LCFs represent the associated 50-year or 10-year LCFs estimated to occur in the involved workforce.

[f] The most severe of the design basis accidents (based on 95 percent meteorological conditions) is used to obtain the population LCF. Higher LCFs would be associated with postulated beyond-design-basis accidents as presented in Chapter 4 and described in detail in Appendix K.

[g] For alternatives that involve more than one site, the transportation impacts for the entire alternative are shown in the first site listed in the alternative. LCFs are from the radiological exposure associated with incident-free operations, radiological accidents, and fatalities expected as a result of vehicle emissions. Traffic fatalities are from nonradiological vehicle accidents. LCFs at Pantex are associated with repackaging requirements if the pit conversion facility were located elsewhere.

[h] Alternatives 3B, 5B, 6C, 6D, 7B, 9B, 12B, and 12D in the SPD Draft EIS have been deleted. Alternative 12C has been renumbered as 12B. Table entries for deleted alternatives have likewise been deleted.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; Haz, hazardous; HLWVF, high-level-waste vitrification facility; LCF, latent cancer fatality; LLW, low-level waste; MLLW, mixed low-level waste; NA, not applicable; TRU, transuranic.

2.18.2 Summary of Lead Assembly Fabrication and Postirradiation Examination Impacts

The impacts on key resources from fabrication of lead assemblies at the five candidate sites (ANL–W, Hanford, LLNL, LANL, and SRS) evaluated in Section 4.27 are summarized in Table 2–5. These areas include waste management, human health risk during normal operations, facility accidents, and transportation. The transportation analysis includes the shipment of plutonium dioxide from LANL to the candidate site; depleted uranium hexafluoride from the representative DOE storage site at the Portsmouth Gaseous Diffusion Plant to the representative conversion facility in Wilmington, North Carolina; uranium dioxide from the conversion facility to the lead assembly fabrication facility; MOX fuel rods from the lead assembly facility to the McGuire reactor for irradiation; and irradiated fuel rods from McGuire to a postirradiation examination facility.[32] Total distance traveled, in kilometers, is provided for each proposed fabrication site. Because facility modification activities would occur inside existing buildings (i.e., no new buildings would be constructed and no additional land would be disturbed), there should be little increase in air pollutants; land disturbances would be minimal; and the number of construction workers would be low. Little or no impacts are expected on any other resources areas.

Impacts from lead assembly and postirradiation examination activities are based on the fabrication of 10 assemblies, although it is likely that only 2 would be needed. If less than 10 lead assemblies were fabricated, the impacts would be lower than those presented in this SPD EIS. Impacts from facility modifications would not be expected to change because the facility modifications would be the same regardless of the number of assemblies produced. Impacts from routine operations, such as resources used, personnel exposure, waste generation, and transportation, would be expected to be reduced in proportion to the number of assemblies produced. The consequences of facility and transportation accidents would be expected to remain the same because the material at risk at any one time would likely not change. However, the risk of these accidents occurring would be reduced as the number of lead assemblies decreased.

There are no appreciable differences in environmental impacts among the five lead assembly candidate sites. There would be little difference in the volume of waste generated at any of the sites. The small differences in TRU waste and LLW would be due to wastes generated during modification of contaminated areas of existing buildings at ANL–W and LANL. In addition, less than 5 m^3 (6.5 ft^3) of hazardous waste would be generated during facility modification and lead assembly fabrication. The total amount of nonhazardous waste generated, primarily sanitary wastewater, would range from 8,700 to 13,500 m^3 (11,380 to 17,658 yd^3). No LCFs for either workers or the public would be expected to result from fabrication of lead assemblies at any of the proposed locations during routine operations. Impacts from facility accidents also show that no LCFs would be expected in the general population at any site from the postulated bounding design basis accident. Comparison of transportation impacts shows little differences among the sites, with no expected traffic fatalities or LCFs. Likewise, there are not expected to be any appreciable differences between the two postirradiation examination sites.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions, on the other hand, could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality were to occur, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the criticality. Beyond-design-basis earthquakes would also have substantial consequences, ranging from workers

[32] Shipments of spent fuel to the potential geologic repository are analyzed in the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D) (DOE 1999b).

being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

The impacts of postirradiation examination at ANL–W and ORNL, as evaluated in Section 4.27.6, would be minimal. No construction waste would be generated. With the exception of nonhazardous wastewater at ANL–W, all categories of waste generated during routine operations would use less than 1 percent of either site's applicable treatment, storage, and disposal capacity. Nonhazardous wastewater at ANL–W would use about 6 percent of that site's applicable capacity. Transportation impacts for postirradiation examination at ANL–W are included in the lead assembly impacts presented in Table 2–5. Transportation impacts for postirradiation examination at ORNL would be lower than those listed in Table 2–5 because the distance traveled would be less.

Table 2–5. Summary of Impacts of Lead Assembly Fabrication at the Candidate Sites[a]

Candidate Site	Waste Management[b] (m^3)	Human Health Risk[c] (dose in person-rem)	Facility Accidents[d]	Transportation[e]
ANL–W	Total TRU waste: 132 Total LLW: 736 Total MLLW: 4 Total Haz: 0	Dose Public: 0.011 Workers: 28 LCFs Public: 5.5×10^{-6} Workers: 0.011	Nuclear criticality LCFs: 1.7×10^{-4}	Radiological LCFs: 8.1×10^{-3} Traffic fatalities: 1.8×10^{-3} Kilometers traveled: 77,000
Hanford	Total TRU waste: 132 Total LLW: 700 Total MLLW: 4 Total Haz: 0	Dose Public: 0.025 Workers: 28 LCFs Public: 1.2×10^{-5} Workers: 0.011	Nuclear criticality LCFs: 2.7×10^{-3}	Radiological LCFs: 8.1×10^{-3} Traffic fatalities: 1.9×10^{-3} Kilometers traveled: 89,000
LLNL	Total TRU waste: 132 Total LLW: 700 Total MLLW: 4 Total Haz: 0	Dose Public: 1.1 Workers: 28 LCFs Public: 5.5×10^{-4} Workers: 0.011	Nuclear criticality LCFs: 3.2×10^{-2}	Radiological LCFs: 8.4×10^{-3} Traffic fatalities: 1.8×10^{-3} Kilometers traveled: 73,000
LANL	Total TRU waste: 137 Total LLW: 705 Total MLLW: 4 Total Haz: 0	Dose Public: 0.025 Workers: 28 LCFs Public: 1.2×10^{-5} Workers: 0.011	Nuclear criticality LCFs: 3.2×10^{-3}	Radiological LCFs: 8.1×10^{-3} Traffic fatalities: 1.6×10^{-3} Kilometers traveled: 49,000
SRS	Total TRU waste: 132 Total LLW: 700 Total MLLW: 4 Total Haz: 2	Dose Public: 6.6×10^{-3} Workers: 28 LCFs Public: 3.3×10^{-6} Workers: 0.011	Nuclear criticality LCFs: 6.5×10^{-4}	Radiological LCFs: 8.3×10^{-3} Traffic fatalities: 1.6×10^{-3} Kilometers traveled: 67,000

[a] Impacts are based on the fabrication of 10 lead assemblies and irradiation of 8. Should only two lead assemblies be fabricated and irradiated, impacts would be lower than indicated.
[b] Totals for 2-year modification and 3-year operation of lead assembly facility.
[c] Annual dose for public residing within 80 km (50 mi) of the candidate site. Worker dose is the same at all five facilities because estimated number of workers and estimated dose to worker does not vary by site. Estimated dose to public varies based on projected population within 80 km (50 mi) of candidate site.
[d] The most severe of the design basis accidents is listed.
[e] LCFs are from the radiological exposure associated with incident-free operations and radiological accidents; traffic fatalities, from nonradiological traffic accidents.

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; LCF, latent cancer fatality; LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; MLLW, mixed-low-level waste; TRU, transuranic.

No LCFs would be expected to either workers or the public from routine postirradiation examination activities. There would be no routine releases of radioactivity to the environment, and thus, radiological impacts on the public. The average annual dose to facility workers would be 177 mrem, for an annual dose to the total facility workforce of 1.8 person-rem. The most severe accident would be a nuclear criticality. Such an accident could result in high, though probably not fatal, radiological exposures to hot cell workers. No LCFs would be expected in the general population.

If DOE were to decide to immobilize all 50 t (55 tons) of surplus plutonium, no lead assembly activities would be required. Should DOE decide to pursue the MOX option, but to not fabricate lead assemblies, such activities would not occur at any of the five sites. Under both of these scenarios, current operations would continue at the sites and the environmental conditions would remain at baseline levels. (See Chapter 3 for a description of the current environmental conditions at the sites.)

2.18.3 MOX Fuel Integrated Impacts

The impacts from implementing the MOX fuel fabrication alternatives would not be limited to those associated with the MOX facility, but would also include impacts from lead assembly fabrication, irradiation, and postirradiation examination, and the use of reactors for irradiation of the MOX fuel assemblies. Any new construction would occur at existing DOE sites. MOX-related operations at all sites would be compatible with, or similar to, activities already occurring at those locations.

Tables 2–6 through 2–11 describe the potential impacts of implementation of the MOX alternatives, from fabrication of the MOX fuel assemblies and lead assemblies to irradiation of the assemblies in domestic, commercial reactors, and the transportation for all radioactive material movements. While these impacts would be cumulative over the life of the campaign, they would not all be concurrent. The data presented are those reported in Chapter 4.

Air emissions, presented in Table 2–6, would result primarily from building heating and vehicular emissions. Releases of criteria pollutants are provided as a range, with the lowest emissions at Hanford, where electricity is the method of heating, and the highest at INEEL, where coal-fired boilers produce steam for heating and travel distances for personnel result in vehicular emissions double those estimated for other candidate sites. Lead assembly fabrication and postirradiation examination activities are relatively small efforts that are not expected to measurably increase air emissions at any of the candidate sites. There are no nonradiological emissions from these facilities that are regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAPs). As discussed in Section 4.32, radiological NESHAPs emissions would be monitored and maintained as part of the total site limit of 10 mrem/yr from all sources. There would be no incremental difference in the air emissions from Catawba, McGuire, or North Anna related to using MOX fuel. Criteria, toxic, and hazardous pollutant emissions are not related to the type of reactor fuel. Rather, emission of these pollutants from the reactor sites would be related to ancillary processes such as operation of diesel generators, periodic testing of emergency diesel generators, and facility operations.

TRU waste and LLW would be generated during operation of both the lead assembly and full-scale MOX facilities (see Table 2–7). The amount of waste generated would be process-specific, and would not vary appreciably by site. Lead assembly fabrication would result in a total of 132 m^3 (173 yd^3) of TRU waste and 700 m^3 (916 yd^3) of LLW waste. The larger amount of waste generated on an annual basis by lead assembly fabrication, as compared to full-scale fabrication, would be attributed to operational differences between fabricating MOX fuel on a laboratory rather than commercial scale. Similarly, activities such as material recycle may not be implemented to as great an extent on the smaller scale. No increase is expected in the amount of waste generated at the reactor sites as a result of using MOX fuel.

Table 2–6. Potential Impacts on Air Quality of MOX Fuel Fabrication and Irradiation

Criteria Pollutant	MOX Facility[a] (kg/yr)	L.A. Fab. and Postirrad. Exam. (kg/yr)	Reactor Operation Increment (kg/yr)	Total MOX Fuel Increment (kg/yr)
Carbon monoxide	35K to 83K	0	0	35K to 83K
Nitrogen dioxide	11K to 32K	0	0	11K to 32K
PM_{10}	31K to 60K	0	0	31K to 60K
Sulfur dioxide	0.1K to 73K	0	0	0.1K to 73K
Volatile organic compounds	4K to 10K	0	0	4K to 10K
Total suspended particulates[b]	31K to 60K	0	0	31K to 60K

[a] Includes vehicle emissions.
[b] Total suspended particulates assumed to be the same as PM_{10}.
[Text deleted.]

Table 2–7. Potential Impacts on Waste Generation of MOX Fuel Fabrication and Irradiation

Waste Type	MOX Facility (m^3)	L.A. Fab. and Postirrad. Exam. (m^3)	Reactor Operation Increment	Total MOX Fuel Increment[a] (m^3)
TRU waste	680	143	0	823
Low-level waste	940	840	0	1,780
Mixed LLW	30	5	0	35
Hazardous	30	1	0	31
Nonhazardous				
Liquid[b]	260K	7.9K	0	268K
Solid	4.4K	5.3K	0	9.7K

[a] Total contribution of MOX effort; based on total lead assembly and postirradiation examination activities and 10 years of MOX fuel fabrication.
[b] Primary contributor is sanitary use, not process-related activities.

More spent fuel would be generated at the reactor sites as a result of the proposed disposition of surplus plutonium as MOX fuel. As discussed in Section 4.28, it is expected that approximately 5 percent additional spent fuel would be generated as a result of MOX fuel irradiation at the proposed reactor sites. Even so, there would be sufficient space at the reactor sites (in either the spent fuel pools or dry storage) to store the additional spent fuel until it could be sent to a potential geologic repository pursuant to the NWPA. DOE's draft environmental impact statement for a potential geologic repository (DOE/EIS-0250D, July 1999) includes the MOX fuel that would be generated from this program.

Existing infrastructure would be adequate to support the MOX fuel alternatives, although it has been estimated that up to 2 km (0.62 mi) of new roads would be needed for the MOX facility (see Table 2–8). Consumption of coal, natural gas, and electricity vary greatly from site to site, for both the MOX and the lead assembly fabrication facilities, depending on the type of fuel used for heating. For example, electricity needed for MOX fuel fabrication would be 30,000 MWh/yr at all sites but Hanford. Hanford, which is estimated to use one and one-half times the electricity of the other sites (46,000 MWh/yr), uses electricity to heat its buildings. INEEL and SRS use coal for heating, and Pantex, natural gas. No additional infrastructure needs would result from the use of MOX fuel at the proposed reactors.

Table 2–9 compiles information about expected radiological impacts on workers during routine operations. The impacts on workers at the MOX facility are based on operating experience at existing MOX facilities in

Table 2–8. Potential Impacts on Infrastructure of MOX Fuel Fabrication and Irradiation

Requirement	MOX Facility	L.A. Fab. and Postirrad. Exam.	Reactor Operation Increment
Electricity (MWh/yr)	30K to 46K	0.7K to 1.2K	0
Water (l/yr)	68M	1.6M	0
Fuel			
Oil (l/yr)	63K	12K to 61K	0
Natural gas (m^3/yr)	0 to 1.1M	0 to 55K	0
Coal (t/yr)	0 to 2.1K	0 to 0.06K	0
Transportation			
Roads (km)	1.0 to 2.0	0	0
Rail (km)	0	0	0

Table 2–9. Potential Radiological Impacts on Workers of MOX Fuel Fabrication and Irradiation

Impact	MOX Facility (over 10 years)	L.A. Fab. and Postirrad. Exam. (over 6 years)	Reactor Operation Increment (over 16 years)
Average worker dose (mrem/yr)	65	451	0
Latent fatal cancer risk	2.6×10^{-4}	1.1×10^{-3}	0
Total dose (person-rem/yr)	22	15	0
Latent fatal cancers	0.088	0.035	0

Europe (DOE 1999a). Impacts on workers at the postirradiation examination facility are based on operating experience at ORNL (O'Connor et al. 1998a). The impacts at the lead assembly fabrication facilities are based on an average annual dose rate of 500 mrem/yr. (This is an administrative limit that has been set in accordance with as-low-as-is-reasonably-achievable principles.) The exposure over the life of the MOX campaign (10 years for the MOX facility, 3 years for lead assembly fabrication and 3 years for postirradiation examination) would result in an increased risk of fatal cancer of 2.6×10^{-4} at the MOX facility, 6.0×10^{-4} at the lead assembly site, and 2.2×10^{-4} at the postirradiation examination facility. The corresponding number of LCFs for MOX facility, lead assembly, and postirradiation examination workers from the MOX campaign would be 0.088, 0.033, and 0.002, respectively. No increase in the incremental dose to workers is expected at the proposed reactors from using MOX fuel.

The potential radiological impacts on the general population from routine operations would be very small. Table 2–10 shows that from routine operations annual doses from the MOX facility to the maximally exposed individual (MEI) range from 1.8×10^{-3} to 1.5×10^{-2} mrem/yr, which translates to an increased risk of fatal cancer of 9.0×10^{-9} to 7.5×10^{-8} for 10 years of exposure. The lowest dose would be received at Hanford; the highest, Pantex. However, the population around Pantex would receive the lowest total population dose, and the lowest annual dose to the average individual. Estimated results at Hanford would be at the high end of the range for both of these parameters, 2.9×10^{-1} person-rem/yr and 7.5×10^{-4} mrem/yr, respectively. The annual dose to the average individual would still be extremely small, and would result in only a 3.8×10^{-9} increased risk of fatal cancer for 10 years of exposure. Offsite dose to the MEI resulting from lead assembly fabrication ranges from a low at SRS of 5.5×10^{-5} to 6.4×10^{-2} mrem/yr at LLNL. The associated risk of fatal cancer would be extremely low for the same MEI, ranging from 8.3×10^{-11} to 9.6×10^{-8}. Annual doses to the average individual at SRS and LLNL would be 8.8×10^{-6} and 1.4×10^{-4} mrem, respectively; risk of LCFs to the same individuals would be 1.3×10^{-11} and 2.1×10^{-10}. Offsite dose to the MEI resulting from postirradiation examination would not be expected to change because the activities would not be additive, but would displace similar activities already being done in these facilities. No change would be expected in the radiation dose to the general population from normal operations associated with the disposition of MOX fuel at the proposed reactors (see Table 2–10).

Table 2–10. Potential Radiological Impacts on the Public of MOX Fuel Fabrication and Irradiation

Impact	MOX Facility (over 10 years)	L.A. Fab. and Postirrad. Exam. (over 6 years)	Reactor Operation Increment (over 16 years)
Annual dose to MEI (mrem)	1.8×10^{-3} to 1.5×10^{-2}	0 to 6.4×10^{-2}	0
Fatal cancer risk	9.0×10^{-9} to 7.5×10^{-8}	0 to 9.6×10^{-8}	0
Annual population dose (person-rem)	0.027 to 0.29	0 to 1.1	0
Fatal cancers	1.4×10^{-4} to 1.5×10^{-3}	0 to 1.7×10^{-3}	0
Annual dose to average ind. (mrem)	8.8×10^{-5} to 7.5×10^{-4}	0 to 1.4×10^{-4}	0
Fatal cancer risk	4.4×10^{-10} to 3.8×10^{-9}	0 to 2.1×10^{-10}	0

Transportation impacts are summarized in Table 2–11, and include radiological dose to the truck crew and the general population, nonradiological emissions from vehicle operation, potential traffic accident fatalities, and LCFs resulting from an accident involving a breach of containment and release of radioactive materials. Shipments analyzed include all those listed in Table 2–3 for the MOX, lead assembly, and postirradiation examination facilities, and shipments of fresh MOX fuel to the proposed reactor sites. The analysis shows that no traffic fatalities or LCFs would be expected from either routine transportation activities or accidents.

Table 2–11. Potential Overland Transportation Risks of MOX Fuel Fabrication and Irradiation

Impact	MOX Facility	L.A. Fab. and Postirrad. Exam.	Total MOX Fuel Increment
Routine radiological			
Crew (LCFs)	6.7×10^{-4} to 1.1×10^{-3}	7.1×10^{-5} to 5.6×10^{-4}	7.4×10^{-4} to 1.6×10^{-3}
Public (LCFs)	5.3×10^{-3} to 7.2×10^{-3}	6.0×10^{-4} to 4.8×10^{-3}	5.9×10^{-3} to 1.2×10^{-2}
Routine nonradiological, emissions (LCFs)	6.2×10^{-3} to 2.3×10^{-2}	7.7×10^{-5} to 3.7×10^{-4}	6.2×10^{-3} to 2.4×10^{-2}
Accidental, traffic (fatalities)	1.7×10^{-2} to 5.9×10^{-2}	4.7×10^{-4} to 1.9×10^{-3}	1.8×10^{-2} to 6.1×10^{-2}
Accidental, radiological (LCFs)	3.2×10^{-3} to 3.8×10^{-3}	5.6×10^{-4} to 3.0×10^{-3}	3.8×10^{-3} to 6.8×10^{-3}

Key: LCFs, latent cancer fatalities.

Accidents are unplanned events which would be different for each type of facility needed to implement the MOX approach. The accidents analyzed for the disposition facilities are presented in detail in Appendix K and the consequences summarized by alternative in Chapter 4 (Sections 4.3 through 4.19 for Alternative 2 through 10, respectively, Section 4.27 for the lead assembly and postirradiation examination alternatives, and Section 4.28 for the reactors). The design basis accident with the most severe consequences postulated for the MOX facility is a criticality. This accident would result in an estimated dose at a distance of 1 km (0.62 mi) from the facility of from 0.15 rem at Hanford to 0.75 rem at INEEL. This same accident would result in doses at the site boundaries ranging from 1.6×10^{-2} rem at INEEL and SRS to 4.7×10^{-2} rem at Pantex. Population doses and LCFs within 80 km (50 mi) would range from 1.0 person-rem and 5.2×10^{-4} LCF at INEEL to 55 person-rem and 2.8×10^{-2} LCF at Hanford. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

The postulated design basis accident with the most severe consequences for proposed lead assembly operations using MOX fuel would be associated with a nuclear criticality. The accident would result in an incremental increase in estimated dose at the site boundaries ranging from 9.3×10^{-4} rem at SRS to 5.3×10^{-1} rem at LLNL. The same accident would result in incremental changes in population doses and LCF probabilities within 80 km (50 mi), ranging from 3.4×10^{-1} person-rem and 1.6×10^{-4} LCF at ANL–W to 6.6 person-rem and 3.2×10^{-3} LCF at LANL, respectively. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. A nuclear criticality would also be the most severe accident at the postirradiation examination facilities, but the amount of spent fuel necessary for such an accident to be physically possible is at least one to two orders of magnitude greater than would normally be available.

The design basis accident with the most severe consequences postulated for the proposed reactors using MOX fuel is a loss-of-coolant accident. This accident would result in an increase in the estimated dose at a distance of 640 m (2,100 ft) from the reactor of 0.001 rem at North Anna to 0.15 rem at McGuire. The same accident would result in incremental increases in doses at the site boundaries ranging from 2.0×10^{-4} rem at North Anna to 0.06 rem at McGuire. The incremental change in population doses and LCFs within 80 km (50 mi) of the reactors would range from 0.9 person-rem and 5×10^{-4} LCF at North Anna to 110 person-rem and 0.06 LCF at Catawba. The frequency of such an accident is estimated to be between 1 in 48,000 and 1 in 130,000 per year.

This SPD EIS also evaluates the potential impacts from a set of postulated highly unlikely accidents with potentially severe consequences at the proposed reactors using both uranium-only and MOX cores. [Text deleted.] Regarding effects of MOX fuel on accident probabilities, the National Academy of Sciences states, ". . . no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel" (NAS 1995:352). Regarding the effects of MOX fuel on accident consequences, the report states, ". . . it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by no more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995:355).

The incremental effects of using MOX fuel in the proposed reactors in place of LEU fuel were derived from a quantitative analysis of several highly unlikely severe accident scenarios for MOX and LEU fuel. The analysis considers severe accidents where sufficient damage could occur to cause the release of plutonium or uranium through a breach of the plant's containment. The consequences of these accident releases on the general population were found to range from minus 4 to plus 14 percent[33] compared with LEU fuel, depending on the accident release scenario. This analysis was based on existing probabilistic risk assessments of severe accidents, and the release scenarios were modeled assuming projected population distributions near the proposed reactors in 2015.

The highest consequence accident at all three of the proposed reactors is an interfacing systems loss-of-coolant accident. However, there is an extremely small chance that this beyond-design-basis accident would ever occur. The likelihood of this accident occurring is 1 chance in 15 million at Catawba, 1 chance in 1.6 million at McGuire, and 1 chance in 4.2 million at North Anna. Were this accident to occur, the increases in the estimated dose at the site boundary for MOX fuel as compared to LEU fuel would be 2,000 rem at Catawba; 2,400 rem at McGuire; and 2,200 rem at North Anna. These increases are 14 percent, 12 percent, and 22 percent, respectively, above the doses expected from the same accident using LEU fuel. The incremental change in population doses and LCFs within 80 km (50 mi) of the reactors have been estimated to be 3.2×10^{6} person-rem and 1,300 LCFs (from 15,600 to 16,900 LCFs) at Catawba; 1.8×10^{6} person-rem and 800 LCFs (from 11,900 to 12,700) at McGuire; and 7.3×10^{5} person-rem and 410 LCFs (from 2,980 to 3,390 LCFs) at North Anna. Prompt fatalities from this accident would be expected to increase from 815 to 843 at Catawba, from 398 to 421 at McGuire, and from 54 to 60 at North Anna. The increase in risk to the population from this accident as a result of using MOX

[33] Accidents severe enough to cause a release of plutonium involve combinations of events that are highly unlikely. Estimates and analyses presented in Section 4.28 indicate an incremental range of postulated LCFs due to the use of MOX fuel of minus 7 to plus 1,300 (in the population within 80 km [50 mi] of the release point), with incremental attendant risks of LCFs over 16 years of reactor operation with MOX fuel of minus 1.3×10^{-3} and plus 1.4×10^{-3}, respectively.

fuel would be 1.4×10^{-3} at Catawba, 8.0×10^{-3} at McGuire, and 1.6×10^{-3} at North Anna over the estimated 16-year life of the MOX fuel irradiation program.

[Text deleted.]

2.18.4 Comparison of Immobilization Technology Impacts

To provide a basis for evaluating alternative immobilization forms and technologies, the environmental impacts associated with operating the ceramic and glass can-in-canister immobilization facilities evaluated in this SPD EIS were compared with the corresponding environmental impacts associated with operating the homogenous ceramic immobilization and vitrification facilities evaluated in the *Storage and Disposition PEIS* (DOE 1996a).

Section 4.29 presents the comparable impacts for key environmental resources (e.g., air quality, waste management, human health risk, and resource requirements) at Hanford and SRS for the homogenous ceramic immobilization/vitrification facilities and the can-in-canister immobilization facilities. Impacts associated with facility accidents, intersite transportation, and environmental justice are also discussed. The results of the comparative analysis are summarized here.

The comparison of impacts is based on immobilizing the full 50 t (55 tons) of surplus plutonium. The *Storage and Disposition PEIS* impact analyses are based on operating facilities that would convert the plutonium into an oxide in one new facility and immobilize it into a homogenous ceramic or glass form in another new facility. Impacts for a plutonium conversion facility are evaluated and itemized separately from the impacts for a ceramic immobilization or vitrification facility. In contrast, this SPD EIS considers the use of both new and existing facilities, and is based on a collocated plutonium conversion and immobilization capability. To compare the impacts, it was therefore necessary to combine the separate *Storage and Disposition PEIS* impact values, as appropriate, to establish a suitable standard of comparison.

Generally, air quality impacts associated with the ceramic or glass can-in-canister technologies would be lower or about the same as those evaluated in the *Storage and Disposition PEIS* for ceramic immobilization or vitrification. With the exception of sulfur dioxide in the ceramic can-in-canister process, all criteria pollutant concentrations associated with either can-in-canister technology would range from being the same to being much lower. Pollutant levels would not be expected to differ between the ceramic and glass can-in-canister processes.

Potential volumes of most waste types resulting from operation of the ceramic or glass can-in-canister technologies would be considerably less than the waste volumes expected from either ceramic immobilization or vitrification technology evaluated in the *Storage and Disposition PEIS*. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in TRU waste volumes of 126 m^3/yr (165 yd^3/yr), compared to the 647 m^3/yr (846 yd^3/yr) of TRU waste estimated in the *Storage and Disposition PEIS* from operation of the homogenous ceramic immobilization facility. Factors contributing to the reduced waste levels associated with the can-in-canister technology would include the use of dry-feed preparation techniques, coordination with existing HLW vitrification operations and the need for a smaller operating work force. Waste volumes would not be expected to differ appreciably between the ceramic and glass can-in-canister processes.

Section 4.29 also presents the potential radiological exposure and cancer risk to the public and involved workers from normal operation of the immobilization facilities. The potential risks to the public associated with either can-in-canister technology would be slightly higher than the homogeneous technologies at Hanford, but lower at SRS. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in population doses of 1.6×10^{-2} or 5.8×10^{-3} person-rem/yr, respectively, compared to the population doses of 8.4×10^{-3} (at Hanford) or 6.6×10^{-2} person-rem/yr (at SRS) resulting from operation of the homogenous ceramic immobilization facility evaluated in the *Storage and Disposition PEIS*. These variations may be attributable to the incorporation of updated source terms, meteorology, population distribution, and other modeling variables in the analysis of the can-in-canister technologies. A comparison between the ceramic and glass can-in-canister technologies indicates operation of the ceramic process would result in slightly higher potential offsite impacts, regardless of whether it is located at Hanford or SRS. For example, the dose associated with operation of the can-in-canister facility at Hanford would result in a population dose of 1.6×10^{-2} person-rem/yr using the ceramic process and 1.5×10^{-2} person-rem/yr using the glass process; the same facility at SRS would result in a population dose of 5.8×10^{-3} person-rem/yr using the ceramic process, and a dose of 5.3×10^{-3} person-rem/yr using the glass process.

The estimated average worker dose and associated cancer risk for the can-in-canister technologies are slightly higher than estimated in the *Storage and Disposition PEIS* for the homogenous technologies. In all cases, however, worker dose would be within the DOE design objective of 1,000 mrem/yr. Potential radiological impacts on involved workers are not expected to differ appreciably between the ceramic and glass can-in-canister processes.

Although some potential hazardous chemical impacts were determined for the homogenous ceramic immobilization/vitrification technologies evaluated in the *Storage and Disposition PEIS*, none are expected for either the ceramic or glass can-in-canister technology because no hazardous chemical emissions would occur from operations.

Because of substantial differences between the *Storage and Disposition PEIS* and the SPD EIS in terms of the specific accident scenarios and supporting assumptions used in the determination of facility accident impacts, a standard basis for comparing homogenous technology and can-in-canister technology accidents is not available. For example, a design basis earthquake scenario was not evaluated in the *Storage and Disposition PEIS* for the plutonium conversion facility, nor were any other design basis accidents evaluated for that facility that could be incorporated with like impacts to the ceramic immobilization or vitrification facility for direct comparison to the accident scenarios presented in this SPD EIS. A design basis earthquake associated with the homogenous approach at Hanford would result in 5.8×10^{-8} and 3.2×10^{-6} LCF in the general population for ceramic immobilization and vitrification, respectively; a design basis earthquake affecting the same facilities at SRS would result in 6.2×10^{-8} and 3.4×10^{-6} LCF, respectively. As discussed earlier in this paragraph these values do not reflect the impact of such accidents on a plutonium conversion facility, and are therefore not directly comparable with the results for the can-in-canister approach shown in this SPD EIS. Comparison of the ceramic and glass can-in-canister processes indicates slightly higher impacts would be associated with the ceramic process. For example, a design basis earthquake at Hanford would result in 9.6×10^{-5} LCF in the general population using the ceramic process, and 8.4×10^{-5} LCF using the glass process. Similarly, a design basis earthquake at SRS would result in 3.6×10^{-5} LCF in the general population using a ceramic process, and 3.1×10^{-5} LCF using a glass process.

In terms of resource requirements, operation of the can-in-canister technologies would require lower amounts of electricity, fuel, land area, and water than would the homogenous technologies evaluated in the *Storage and Disposition PEIS*. Fewer workers would be required to operate the can-in-canister technologies, which in turn would result in lower socioeconomic impacts. Resource requirements differ between the ceramic and glass can-in-canister processes in that electricity requirements would be greater to support the ceramic process at either site (i.e., the ceramic process would require 29,000 or 24,000 MWh/yr at Hanford or SRS, respectively, compared to the 28,500 or 23,000 MWh/yr, respectively, required for the glass process).

The *Storage and Disposition PEIS* analysis assumes that canisters of plutonium immobilized with radionuclides would be transported to a potential geologic repository via rail. This SPD EIS analysis, however, conservatively assumes that the immobilized canisters would be shipped by truck from the immobilization site to the repository, with one canister being transported per truck shipment.[34] The ceramic and glass can-in-canister technologies would result in fewer total potential fatalities from intersite transportation than would the homogenous ceramic immobilization/vitrification technologies evaluated in the *Storage and Disposition PEIS*. Because the ceramic can-in-canister process would produce fewer canisters, it would result in somewhat lower routine and accidental transportation impacts than the glass can-in-canister process.

Evaluations of both the homogenous ceramic immobilization/vitrification technologies and can-in-canister technologies included routine facility operations and transportation as well as accidents. No significant risk to the general population would be expected to occur for normal operations or in the event of a design basis accident. [Text deleted.] Similarly, implementation of these technologies would not result in a significant risk of disproportionately high and adverse impacts on minority or low-income groups within the general population.

34 The *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D) (DOE 1999b) analyzes spent fuel shipments by rail and truck. No decision has been made as to the mode of transportation.

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