

Impact of Higher Tails Assays on Worldwide Cost of Nuclear Power and Worldwide Cost of Electricity

This spreadsheet tab estimates the impact on the average worldwide cost of nuclear power in the year 2020 from "doing without" the National Enrichment Facility.

The methodology: calculate the changes in the amounts of uranium mining/milling activity, uranium enrichment, and radioactive uranium "tails" requiring disposal; and also to postulate possible changes in the unit costs of these activities on account of the increased volumes required due to the less-efficient utilization of uranium "feed" assumed in the absence of the N.E.F.

Because of sharply divergent estimates of the cost to dispose of depleted uranium, we have two base cases: one, shown in the column denoted (1), uses LES's assumptions to the maximum extent possible; the other uses the same assumptions but substitutes IEER's highest estimate (from late 2004) of the cost to dispose of DU.

The result, shown on the second page, in the row Difference from baseline, is that the net cost of these three "steps" will be as little as \$147 million (a year) under the no-N.E.F. scenario, assuming no changes in unit costs; and no more than \$938 million.

The later rows of this worksheet show that these cost differentials are extremely small in the context of the worldwide nuclear power enterprise projected for 2020. It would add at most two-thirds of one percent to the average cost of nuclear power in that year, and probably considerably less. Since nuclear power is projected to account for only 13% of electricity production in that year, the impact on the average cost of electricity would be almost an order of magnitude less, i.e., between one part in 1,180 and one part in 7,410.

All figures are for 2020 and apply to the worldwide nuclear power sector unless noted.

	Scenarios w/ LES cost for DU			Scenarios w/ IEER cost for DU			Data Sources
	(1)	(2)	(3)	(4)	(5)	(6)	
	LES Base	LES Alt 1	LES Alt 2	IEER Base	IEER Alt 1	IEER Alt 2	
Assumptions re quantities and costs	Uses LES assumptions to maximum extent possible	Same as (1) except that higher tails assay changes quantities	Same as (1) but w/ higher unit costs from more U + DU usage	Same as (1) except uses IEER high cost for DU	Same as (4) except that higher tails assay changes quantities	Same as (4) but w/ higher unit costs from more U + DU usage	
GWe	390.1	390.1	390.1	390.1	390.1	390.1	LES file: Tables&Figures.xls, Tab1GWe
Avg CF	84.5%	84.5%	84.5%	84.5%	84.5%	84.5%	LES file: Region.out, p. 14
TWh/yr	2,890	2,890	2,890	2,890	2,890	2,890	Calculation using two prior rows
A. Uranium Mining & Milling							
U3O8 requirements (millions of pounds)	179.80	199.70	199.70	179.80	199.70	199.70	All columns are from LES file, Region.out, p. 8. Columns 2,3,5 and 6 are from runs w/ CK tails assays. See this spreadsheet, U vs. SWU http://www.world-nuclear.org/info/inf22.htm : "The above graph, from Int'l Nuclear Inc., shows a cost curve for world uranium producers, and suggests that for 45,000 t/yr U3O8 production from mines (just above present level), US\$15/lb is a plausible price.
Price per pound of U3O8	\$20	\$20.00	\$22.00	\$20	\$20.00	\$22.00	
U3O8 unit price incrs (where applicable)		0%	10%		0%	10%	
Mining & Milling expenditures, millions	\$3,596	\$3,994	\$4,393	\$3,596	\$3,994	\$4,393	Calculation using three prior rows
Increase, millions \$		\$398	\$797		\$398	\$797	Calculation using prior row

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Nuclear Power and Worldwide Cost of Electricity (cont'd.)**

B. Enrichment (w/o tails disposal)

Millions SWU/yr	42.68	39.65	39.65	42.68	39.65	39.65	All columns are from LES file, Region.out, p. 9. Columns 2,3,5 and 6 are from runs w/ CK tails assays. See this spreadsheet, U vs. SWU The spot price in mid-late 2004 was \$110. See UX Weekly 2004, p. 3 (http://www.uxc.com/products/UxW18-41.pdf). All cases use same price since supply-demand balance is unchanged.
\$ per SWU	\$100	\$100	\$100	\$100	\$100	\$100	
Enrichment expenditures, millions \$	\$4,268	\$3,965	\$3,965	\$4,268	\$3,965	\$3,965	
Increase, millions \$		-\$302	-\$302		-\$302	-\$302	Calculation using two prior rows
							Calculation using prior row

C. Enrichment Tails Disposal

UF6 to enrich (000 metric tons of U)	68.10	75.63	75.63	68.10	75.63	75.63	All columns are from LES file, Region.out, p. 8. Columns 2,3,5 and 6 are from runs w/ CK tails assays. See this spreadsheet, U vs. SWU This spreadsheet, Mass Balances tab, inputting average tails assays to the standard mass-balances equation $F/P = (X_p - X_t) / (X_n - X_t)$.
% of inputs that end as tails	89.3%	90.4%	90.4%	89.3%	90.4%	90.4%	
DUF6 tails (000 metric tons of U)	60.83	68.33	68.33	60.83	68.33	68.33	Calculation using two prior rows
Cost to dispose of a kg of DU	\$6.76	\$6.76	\$7.44	\$30.41	\$30.41	\$33.45	(1) is sum of \$5.50 (NEF Safety Analysis Report, p. 10.3-1) + \$1.26 (IEER, citing ERI 2003 Draft). (4) is highest cost in Makhijani & Smith, Nov. 2004 report, IEER, p. 51, Table 9.
DU unit price incrs (where applicable)		0%	10%		0%	10%	CK assumption
Enrichment tails disposal, millions \$	\$411	\$462	\$508	\$1,850	\$2,078	\$2,286	Calculation using three prior rows
Increase, millions \$		\$51	\$97		\$228	\$436	Calculation using prior row

A, B & C combined, millions \$	\$8,275	\$8,421	\$8,867	\$9,713	\$10,037	\$10,645	Simple addition of three boldface rows on this and previous page
Difference from baseline (millions \$)		\$146	\$592		\$324	\$931	Calculation using prior row
Difference (cents per kWh)		0.0051	0.0205		0.0112	0.0322	Calculation, dividing prior row by TWh figures on previous page
Bus-bar cost of nuc. power (cents/kWh)	5.000	5.005	5.020	5.050	5.061	5.082	CK estimate
% differential, alt scenarios vs. baselines		0.10%	0.41%		0.22%	0.64%	Calculation using prior row
Reciprocal of previous quantity		990	240		450	160	Calculation using prior row
Projected World Electricity Generation	21,838	21,838	21,838	21,838	21,838	21,838	This spreadsheet, World kWh tab
Nuclear Power's Share	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%	Calculation, dividing TWh figures on previous page by prior row
% incrs in avg elec cost in alt scenarios		0.013%	0.054%		0.029%	0.084%	Calculation: product of two prior rows whose entries are percentages
Reciprocal of previous quantity		7,460	1,840		3,400	1,180	Calculation using prior row