

CHAPTER 17 – TABLE OF CONTENTS

17	DECOMMISSIONING	1
17.1	Decommissioning Plan	1
17.1.1	Cost Estimate	1
17.1.2	Escalation of Cost Estimate to Future Years	2
17.2	References.....	2

List of Tables

Table 17.1:	Decommissioning Cost Summary – NIST Reactor	3
Table 17.2:	NIST Direct Costs For Reactor Decommissioning In Years Immediately Following Shutdown	4

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17 DECOMMISSIONING

The present plan for the NBSR is that the reactor and all associated buildings will be decommissioned, decontaminated, and disassembled at the end of life. The entire site will be returned to unrestricted use. Duratek, Inc. was contracted to prepare an independent cost estimate of all external costs (excluding all NIST direct costs), and to provide a formula for out-year cost escalation. Of necessity, this estimate addresses the five elements required in a preliminary decommissioning plan. In addition, when the facility ceases operation, there will be direct costs to NIST, which will continue until the site is released for general use.

17.1 Decommissioning Plan

A detailed, independent cost estimate and preliminary demolition plan has been prepared for the NIST reactor and associated structures.

17.1.1 Cost Estimate

In studying the decommissioning of the NBSR, Duratek (2004) considered three alternatives for the NIST reactor:

DECON – full scale decommissioning, decontamination, and demolition, restoring the site for unrestricted use as soon as possible after cessation of operations,
SAFSTOR – the facility is maintained and monitored to allow decay of radioactivity, after which it is decommissioned,
ENTOMB – the reactor structures are “permanently” entombed in an appropriate enclosure.

The option chosen for detailed examination was DECON, in view of the Nuclear Regulatory Commission (NRC) strong preference for timely decommissioning, unless there are no other options. The SAFSTOR option was priced for various time periods by comparison to NRC estimates for the reference research reactor. This comparison concluded that the DECON option is the only cost-effective solution.

A breakdown of the major technical activities for DECON and their associated costs is shown in Table 17.1. Details of this cost estimate are provided in Duratek (2004). In summary, the total estimated cost in 2003 for complete Decommissioning, Decontamination and Disassembly costs (excluding NIST direct costs) is \$30.2 million. To obtain a complete estimate, the direct costs to NIST must be added. These direct costs are estimated in Table 17.2.

The reactor fuel will not be sufficiently decayed for final shipment until at least two years after operation ceases. So long as fuel is on-site, fully licensed operators must be kept on staff to oversee, handle, and prepare it for final shipment. Routine expenses such as utilities, infrastructure maintenance, health physics surveillance, and security must be provided and paid

for, since no ongoing program will bear the expense. For the first two years, operational costs will continue unchanged; after that, they will gradually decline to zero.

From the table, the grand total of estimated NIST direct costs for decommissioning is \$25.9 million. Adding this to the estimate of external costs developed by Duratek, the grand total cost estimate for complete decommissioning of the NIST reactor and associated structures is \$56.1 million, including a 25% contingency on the external costs, but no added contingency on the NIST direct costs.

NIST is a Federal agency, located in the Technology Administration of the Department of Commerce. When operation of the reactor is terminated, NIST will request funding for the immediate decommissioning described here.

17.1.2 Escalation of Cost Estimate to Future Years

As part of the cost estimate provided by Duratek¹, an algorithm for escalation based on NUREG-1307, Rev 10, was prepared. In this algorithm, the cost of decommissioning is given by:

Estimated Cost in Year X = $(A*L_x + B*E_x + C*B_x) * (\text{Cost in 2003})$,

where

A = Fraction of 2003 costs attributable to labor = 0.612

B = Fraction of 2003 costs attributable to energy = 0.036

C = Fraction of 2003 cost attributable to burial = 0.352

L_x = Labor cost adjustment from December, 2003 to date of new estimate

E_x = Energy cost adjustment from December, 2003 to date of new estimate

B_x = Burial cost adjustment from December, 2003 to date of new estimate.

L_x and E_x are estimated from national producer price indices, adjusted for local conditions. These data are available from the Bureau of Labor Statistics website at www.bls.gov, as described in (Duratek, 2004).

17.2 References

Duratek, Inc (2004). *Decommissioning Cost Estimate for the National Institute of Standards and Technology Reactor*. Oak Ridge, TN.

Table 17.1: Decommissioning Cost Summary – NIST Reactor

Operation	Man-hours	Labor Plus Trav. & Liv.	Waste Process & Transport	Equipment, Contracts & Supplies	Radwaste Ship & Disposal	Total Cost
"A" Wing Cold Labs and Offices	8,001	\$541,674		\$96,359	\$64,651	\$702,684
"B" Wing Warm Labs and Offices	5,586	\$377,379	\$15,371	\$74,806	\$169,368	\$636,924
"B" Cold Labs and Offices	6,084	\$412,097		\$70,861	\$12,854	\$495,812
Reactor Main Building "C"	33,418	\$2,221,896	\$999,346	\$506,304	\$6,302,966	\$10,030,511
Pump Rooms "D"	2,444	\$165,327	\$105,518	\$20,225	\$42,248	\$333,318
"E" Cold Labs and Offices	8,347	\$565,372		\$97,346	\$19,552	\$682,270
Compressor Rm "F"	1,449	\$98,178		\$10,543	\$3,060	\$111,781
Guide Hall "G"	11,487	\$778,019		\$134,714	\$104,443	\$1,017,176
Waste Annex "H"	605	\$39,729		\$20,173	\$199,263	\$259,166
Experimental support Space "J"	1,840	\$124,615		\$21,456	\$4,302	\$150,373
Cooling Towers	1,396	\$94,425	\$32,968	\$13,494	\$21,704	\$162,591
Outdoor Area	36,824	\$2,494,131	\$37,108	\$183,953	\$99,487	\$2,814,680
Demolition	56,548	\$3,830,317		\$1,212,818	\$116,462	\$5,159,597
D&D Planning	480					\$45,600
Char. Surveys	2,535					\$255,541
Final Surveys	10,140					\$1,022,165
Planning, Training, & Mob.	1,620					\$88,915
Owner Oversight & Licensing	3,311				\$64,651	\$210,476
Totals	192,115	\$13,297,419	\$1,190,310	\$2,531,492	\$7,160,359	\$24,179,580
					25% CONTINGENCY	\$6,044,895
					GRAND TOTAL	\$30,224,476

Table 17.2: NIST Direct Costs For Reactor Decommissioning In Years Immediately Following Shutdown

Cost Element	Year 1	Year 2	Year 3	Year 4	Year 5
Licensed operators, engineering and management ¹	6,000,000	6,000,000	4,000,000	2,000,000	1,000,000
Health Physics	850,000	700,000	500,000	250,000	250,000
Security	500,000	500,000	500,000	300,000	0
Utilities	150,000	150,000	150,000	100,000	0
Spent fuel shipment	0	1,000,000	1,000,000	0	0
Total	7,500,000	8,350,000	6,150,000	2,650,000	1,250,000
Grand Total					25,900,000

¹ Assumes operations costs equal to those in 2003, based on the need for a fully licensed staff until fuel is completely shipped by the end of Year 3.