8/21/07

SNM-362 Decommissioning Funding Analysis
Historical Reference

In late 1993 NIST performed a decommissioning funding analysis which was submitted to the NRC. A letter received May 4, 1994 from Robert Pierson, USNRC Chief of Licensing Branch, under Docket 70-398, License SNM-362, TAC No. L30550 indicates that the document was reviewed and no deficiencies were identified. This previous analysis included sections of the NBSR which are now covered by the NBSR (TR-5 license) related decommissioning funding plan. It also included removal of residual activation in portions of the NIST 100 MeV accelerator facility. It is recognized that these are NIST responsibilities but they are separate and distinct from the liabilities associated with the SNM-362 materials license, and are not included with the current cost estimates. That previous analysis did not include costs for removal of the existing source inventory, which have now been included in the current analysis.

The 1993 document was prepared in accordance with Reg guide 3.66, and Nureg 1754 including the 1988 addendum 1. They summarized costs in 1993 dollars as the follows:

1. Radioactive Materials Laboratory Facilities	$1,071,372
2. Accelerator Facilities	$ 481,074
3. Laboratory portions of the Reactor Facility	$1,834,260
Total	$3,386,706

The 1993 study included a cost escalation that projected total costs as follows:

1995	$3,735,327
2000	$4,577,053
2010	$6,265,406
2025	$8,805,436

The 1993 study projected costs in 2010 at $6.3 million of which approximately $1.9 million would be required to cover the laboratory decontamination and clearance portion addressed in the current declaration of intent. The current declaration is based on updated costs instead of projected estimates. In the current study the laboratory decommissioning and clearance cost is estimated to be $1.5 million in 1997 dollars (plus $1.2 million for source inventory removal).

Operations:

There are two fundamental operations for decommissioning the facilities. The first operation is transfer of the sources from the facility. This will either be transfers to other authorized users, such as previous suppliers, other research facilities, SRM customers, or DOE facilities, or for waste disposal. The second major operation is the characterization, decontamination, and clearance of the facilities for other uses. The final cost estimate will entail only those required for that characterization, decontamination and clearance. It will not include costs associated with the refurbishment of the facilities for other uses

or salvage and building demolition operations to return the campus to a "green field" condition.

It should be noted that with few exceptions – notably those sources that must be maintained for standards traceability, and those sources in active use, the transfer of sources to other facilities should be an ongoing operation. As such this would not be covered by the decommissioning funding costs. While substantial costs may be incurred for disposal or disposition of legacy sources, these should be transferred long before license termination or facility decommissioning. Should that not occur the costs for source disposal at license termination will be substantially greater. For purposes of determining decommissioning funding it shall be assumed that acquisition of new sources shall be terminated some time before license termination and the existing inventories of prepared standards shall be greatly reduced. Therefore the costs for source disposition should only cover those sources expected to still be in use or storage at the time of decommissioning.

Source Disposition:

This analysis presumes a steady state inventory at the current levels. If done appropriately the actual inventory at the time of license termination should be reduced. Current inventory records indicate approximately 1500 sources of which approximately 500 are sealed, encapsulated or plated solid discrete sources. Sixteen of these rise to the level where substantial shielding and shipping arrangements will be required to return them either to the manufactures or the Department of Energy. Costs for transporting these sixteen sources, including arrangements for specialized transport casks, contract shipping experts, and vehicles, are estimated to be approximately $25,000 each or a total of $400,000. (This price varies from less than $5000 for sources that are "special form " and already contained in approved shipping containers, to $60,000 for sources that would be required to be transferred to specialized shipping casks) Most of the remaining sealed sources could be disposed of with less stringent shipping and packaging requirements. The majority are below the threshold requiring leak testing, i.e. below 10 uCi. It is estimated disposition of these lower level sealed sources could be performed for approximately $300,000. The remaining "unsealed" source material is of substantially lower activity and generally shorter half lives. It is estimated that these could be disposed of for approximately $500,000. Please note that this is subject to the availability of waste disposal and processing facilities. Current uncertainties in the status of existing disposal and processing facilities make it very difficult to predict long term future costs. (Reference estimates by James Clark NIST HP primary COTR for rad-waste contracts and based on previous shipments.)

The total source removal and disposition costs for license termination are therefore estimated to be approximately $1.2 million.

Characterization, Decontamination, and Clearance Process:

License records indicate that since establishment of the NIST Gaithersburg Campus 162 rooms (56429 sq ft) located in 13 buildings have been authorized for unsealed source work under the SNM-362 license or the predecessor licenses. (This does not include those labs located in building 235 which are already covered by the TR5 license decommissioning plan).

An additional 113 locations (56599 sq ft) in 16 buildings have been authorized for sealed source use or storage. Of these 74 (36851 sq ft) are currently in active use. The sources have been removed from the remainder and the areas verified to be clear for other purposes.

The decommissioning of a sealed source use and storage area is relatively straight forward:

- The sources are removed and transferred off site.
- Sealed source leak test records are reviewed to verify there were no instances of source leakage in the rooms.
- A survey is performed to verify that all sources of radiation have been removed
- If there are indications either in the records or in the survey results suggesting possible source leakage or unsealed source use, the room is referred to the unsealed source facility clearance process
- Once cleared, all radioactive material or radiation area posting is removed.
- Records are updated to indicate the facility has been cleared for unrestricted use.

The decommissioning of unsealed source use and storage areas is substantially more complex. Each facility where unsealed sources have been used or stored must be characterized. This decommissioning process should conform to the requirements of the MARRSIM process.

The characterization entails:

- Review of the source term and utilization records
- Implementation and documentation of a QA plan for all instrumentation
- Predetermined thresholds and response plans for monitoring results
- Statistical analysis for determining how and where the measurements should be taken in accordance with MARRSIM guidance
- Sampling and monitoring in accordance with the plan
- Evaluation of the monitoring results
- Decision for further action or clearance.
- Final status characterization
- Documentation of the results.

After the screening characterization, items with identified contamination shall be decontaminated or dismantled for radioactive waste disposal. An iterative process of decontamination followed by confirmatory monitoring is followed until clearance levels

are achieved. A final status survey shall then be performed and documented to assure free release criteria are satisfied.

In general the need for laboratory cleanliness to prevent cross contamination of experiments and to minimize exposure to the NIST staff assures that we operate well below the criteria for clearance (based on screening values from NUREG 1757). For example the screening values are generally above 7000 DPM per 100 sq cm. Our internal procedures require decontamination or posting and controlling the area above 200 DPM/ sq cm. With a few notable exceptions much of the decommissioning effort will be a confirmation that the conditions are acceptable for release of the facility controls.

Decommissioning Cost Basis:

A variety of sources were used to form the cost basis for the decommissioning process. These include:

- study and experience of NIH health physics section for laboratory clearance and free release
- Experience of NIH for laboratory clearance, dismantling, decommissioning and clearance related to chemical HAZMAT contaminated labs.
- The NBSR Decommissioning Plan cost estimates for the laboratory and office spaces
- The NIST plant engineering estimates for dismantling and lab refurbishment.

Monitor, Clean and Release:
The first which shall be referred to as the "monitor, clean, and release" option was provided by health physics section at NIH based on a study and operations performed by the Radiation Safety Academy of Gaithersburg Maryland. It covers the monitoring, decontamination, and free release clearance of several NIH radioactive materials laboratories at a variety of research facilities throughout the metropolitan area. The analysis was for laboratories that are analogous to those covered by the SNM-362 license. It does not cover the full dismantling of the laboratories. It does not cover the costs of refurbishing these labs for other purposes. It does not cover the costs for a "green field" demolition of the buildings. It also does not cover the costs for disposal of the original source materials. It only covers the removal of contaminated surfaces and the demonstration that the facility conditions would satisfy the free release criteria. The NRC decommissioning criteria require doses to an average exposed individual who uses the facility for unrestricted and uncontrolled purposes be less than 25 millirem per year and as low as reasonably achievable.

This NIH study included sixty four separate facilities totaling 4,089,077 square feet of occupied laboratory space. It was estimated that 8632 square feet were contaminated and required decontamination or disposal. The estimated cost including labor, equipment, supplies, and waste disposal for the monitoring, decontamination, dismantling and disposal, and final clearance characterization was $5,653,072 or roughly $1.39 per square foot. The primary isotopes involved in the NIH study were H-3 and C-14. Although these are moderately long half life materials they are of relatively low radio-toxicity (and

therefore very high acceptable screening values for residual contamination). While many aspects of this operation are similar to those in NIST laboratories the source term of isotopes with higher levels of radio-toxicity may drive up the costs by increasing the amount of surface material that must be cleaned or removed. This option will be viable for virtually all the sealed source use locations on the NIST campus and may apply to many of the lower activity, lower radio-toxicity, or shorter half life unsealed source laboratories. Applying this only to the NIST sealed source laboratories- $1.39 X 56,599 sq ft = $78,673 for monitor, clean, and release of sealed source use laboratories after the sources have been removed.

Dismantle, Dispose, Monitor, and Release:
The second source for estimating laboratory clearance costs also came from NIH. It is based on the typical costs for clearing a laboratory used for biological or chemical hazards. This typically required more active facility cleaning and dismantling/removal and disposal of flooring, lab benches, hoods, sinks, etc. Based on estimates provide by NIH the price typically ranges from $15 to $25 per square foot of lab space. There is an economy of scale for the operations and some smaller specialized laboratories have exceeded $60 per square foot. This may be an appropriate option for the decommissioning of many of the higher activity laboratories for example the B and E wings of Building 245, if NIST intends to completely renovate the building or laboratory section. Applying this to the unsealed source laboratories - $25 sq ft x 56,429 sq ft = $1,410,725 for dismantle, dispose of waste, monitor and release for unsealed source laboratories. This approach does not include the costs for refurbishing the labs for other productive purposes.

Green Field Option:
The third source for estimating decommissioning costs comes from the NBSR decommissioning plan for the section of the building that house the clean offices, the clean sample preparation labs, and the "warm" radioactive materials laboratories. This does not include the sections particular to the reactor operations or the neutron beam experimental areas. The NBSR decommissioning plan uses a "green field" option where it is presumed that the specialized nature of the facility will make it unsuitable for renovation for another purpose. Instead the facility is to be fully decontaminated, gutted and the building demolished leaving the field open and available for other uses.

The A-wing clean sample preparation laboratories and offices constitute approximately 28246 square feet. Estimated decommissioning costs are roughly $25 per square foot. The B wing cold laboratories and offices constitute 14,493 square feet and are estimated to cost $34 per square foot. The B-wing "warm" radioactive materials labs constitute 13,200 square feet and are estimated to cost $49 per square foot for full dismantling, disposal and demolition. Using the NBSR approach of a complete decontamination and demolition of the unsealed source labs the costs would be $49 /sq ft x 56,429 sq ft = $2,765,021 for decommissioning. Additional building specific engineering studies would be required to fully identify costs for dismantling the buildings. This only serves as an initial estimate.

This "Green Field" option may be an appropriate approach if the decision is made to completely gut and demolish one of the NIST laboratory buildings at license termination. This effort to estimate decommissioning cost for the SNM-362 license covers the use of NRC licensed radioactive materials at NIST. There would be additional costs associated with full decommissioning of building 245 because of residual induced activity in the walls and structure from the use of the original 100 MeV linear accelerator.

Dismantle and refurbish:

The final source of decommissioning cost information comes from plant engineering which provided a generic estimate of costs for gutting and refurbishing a general laboratory unit here at NIST. These costs include the costs for asbestos abatement but do not include the costs for other hazardous material monitoring or abatement. They include the costs for stripping all fixtures and surfaces in the laboratory. They also include the costs for refurbishing the laboratory with the standard complement of lab benches, hoods, flooring, and updated lighting and electric. As such these costs include demolition costs and the future investment for reuse of the facility for other purposes, but do not include the monitoring or radioactive waste disposal that is an essential part of the decommissioning plan. They are presented primarily as a gauge of the investment required to replace or reuse the facilities for other purposes. NIST plant estimates the full gut and refurbishment cost of a typical laboratory unit to be approximately $90,000 per unit if the existing HVAC system is used. The costs would increase by roughly $50,000 to $140,000 per unit if the operation included complete removal and replacement of the HVAC systems to the exhaust point. $140,000 x 162 unsealed source labs = $22,680,000 This estimate represents the cost for replacement of the laboratory capacity. It is beyond the scope of the NRC's decommissioning requirements, but remains a consideration for NIST budgetary planning needs.

Final Decommissioning Cost Estimate:

Activity	Cost Basis	Cost
High Activity Sealed Source Transfer to DOE or Manufacturers	16 X $25000 each	$400000
Lower Activity Sealed Source Disposal		$300,000
Unsealed source disposal or transfer		$500,000
Sealed Source Lab Survey and Clearance	56,599 sq ft x $1.39/sq ft	$79,000
Unsealed Source Lab – Dismantle – dispose-Monitor and Clear	56,429 sq ft x $25/sq ft	$1,411,000 *
	Total =	**$2,690,000**

*This presumes a dismantling of the surfaces, decontamination or disposal of contaminated materials, and monitoring to assure adequate decontamination to meet release criteria, and final release. It does not include any refurbishment of the laboratories for other uses or full demolition of the buildings. Following the license decommissioning those costs will still be required for NIST to utilize the space or transfer the space to other organizations. Per plant engineering estimates the full refurbishment costs are roughly 8 times higher than the radiological decommissioning costs.

It should be noted that this analysis applies only to the decommissioning of activities from the materials license. It does not cover any portion of Building 235 which is covered by the NBSR decommissioning plan. In addition other areas of Building 245 have residual induce activity due to accelerator operations conducted from the 1960s through the 1980s. These are not considered in this analysis but will require additional resources to address before all portions of the building may be release for uncontrolled use.