

APPENDIX 1 TO ATTACHMENT 4: CONTRACTOR'S 12/98 WORKING DRAFT – RISK ANALYSIS AND EVALUATION OF REGULATORY OPTIONS FOR NUCLEAR BYPRODUCT MATERIAL SYSTEMS (under separate cover)

**APPENDIX 2 TO ATTACHMENT 4: BASIS FOR BARRIERS (under separate cover)**

**APPENDIX 3 TO ATTACHMENT 4: PRELIMINARY COMPARISON OF SYSTEM RANKINGS  
WITH RESPECT TO RISK DEVELOPED FROM THE  
CONTRACTOR WORKING DRAFT REPORT AND THE  
RESULTS OF THE SURVEY OF NRC AND AGREEMENT  
STATE MATERIALS LICENSING AND INSPECTION  
PERSONNEL**

Comparison of System Ranks Based on Survey and Contractor Annual Dose Estimates to Workers

| System Number (Survey) | System Number (Sciencetech) | System Name (as used in survey)  | Rating* (survey) | Rank (survey) | Rank** (Sciencetech) |
|------------------------|-----------------------------|--|------------------|---------------|----------------------|
| 41b                    |                             | decontamination services   | 785              |               |                      |
| 22                     | 40                          | radiography - field use  | 482              | 1             | 1                    |
| 34                     | 32                          | manufacturing of sources containing solids                                 | 362              |               |                      |
| 16                     | 15                          | nuclear pharmacies   | 355              | 2             | 14                   |
| 5                      | 4                           | 10 CFR 35.200 - nuclear medicine with generator(s)                         | 294              | 3             | 5                    |
| 21                     | 19                          | radiography - permanent installation                                       | 262              | 4             | 9                    |
| 35                     | 33                          | manufacturing of sources containing liquids                                | 236              |               |                      |
| 9                      | 8                           | brachytherapy - manual afterloading  | 231              | 5             | 3                    |
| 36                     | 34                          | manufacturing of sources containing gases                                  | 223              |               |                      |
| 7                      | 6                           | 10 CFR 35.300 - nuclear medicine   | 211              | 6             | 12                   |
| 41a                    |                             | nuclear laundries  | 210              |               |                      |
| 19                     | 17                          | well logging - tracers and field flood studies                             | 171              | 7             | 6                    |
| 33                     | 31                          | manufacturing or distribution of devices containing sealed sources         | 167              | 8             | 19                   |
| 6                      | 5                           | 10 CFR 35.200 - nuclear medicine without a generator                       | 155              | 9             | 4                    |
| 8                      | 7                           | brachytherapy using seeds  | 154              |               |                      |
| 20                     | 18                          | well logging - using sealed sources  | 135              | 10            | 8                    |
| 39                     | 37                          | packaging of waste   | 129              | 11            | 7                    |
| 17                     | 16                          | veterinary use   | 125              |               |                      |
| 40                     | 38                          | solidification of waste  | 111              | 12            | 26                   |
| 4                      | 14                          | 10 CFR 35.100 - nuclear medicine and human use research                    | 102              |               |                      |
| 10                     | 9                           | brachytherapy - low dose rate remote afterloading                          | 91               | 13            | 13                   |
| 38                     | 36                          | compacting of waste  | 89               | 14            | 10                   |
| 15                     | 13                          | gamma stereotactic surgery   | 88               |               |                      |
| 11                     | 10                          | brachytherapy - high dose rate remote afterloading                         | 76               | 15            | 18                   |
| 1                      | 1                           | R&D synthesis laboratories   | 66               | 16            | 17                   |
| 23                     | 20                          | pool irradiators   | 65               | 17            | 20                   |
| 18                     | 25                          | R&D on animals   | 63               |               |                      |
| 27                     | 24                          | portable gauges  | 58               | 18            | 11                   |
| 12                     | 11                          | brachytherapy - eye applicator   | 56               |               |                      |
| 14                     | 12                          | teletherapy devices  | 56               |               |                      |
| 37                     | 35                          | incineration of waste  | 44               | 19            | 23                   |
| 13                     | 39                          | 10 CFR 35.400 - diagnostic devices   | 42               |               |                      |
| 28                     | 26                          | x-ray fluorescence devices   | 27               | 20            | 16                   |
| 2                      | 2                           | R&D laboratories using carbon, hydrogen, iodine, phosphorus, and sulfur    | 26               | 21            | 22                   |
| 13a                    | 39                          | 10 CFR 35.500 - diagnostic devices   | 25               |               |                      |
| 31                     | 29                          | small sealed sources or devices (e.g., those used under a general license) | 21               |               |                      |
| 25                     | 22                          | fixed gauges - gamma emitters  | 20               | 22            | 21                   |
| 24                     | 21                          | self-shielded irradiators  | 13               | 23            | 2                    |
| 26                     | 23                          | fixed gauges - beta emitters   | 11               | 24            | 15                   |

Comparison of System Ranks Based on Survey and Contractor Annual Dose Estimates to Workers

|    |    |  |    |    |    |
|----|----|--|----|----|----|
| 30 | 28 | other measuring devices  | 11 |    |    |
| 3  | 3  | in vitro laboratory testing  | 9  | 25 | 24 |
| 29 | 27 | gas chromatographs   | 6  | 26 | 25 |
| 32 | 30 | very small sealed sources of devices (e.g., those used under an exemption) | 5  |    |    |

"Survey rating is based on the mean estimated annual dose for individual workers for each system calculated from respondents opinions.  
 The review group recognized that, in calculating those means using the unequal class intervals provided to the respondents, low dose estimates received less weight than high dose estimates.

While this was recognized as reducing the value of the mean as an indicator of annual dose to workers, it was judged to be "close enough" to developing a ranking of systems for a "ballpark" comparison of survey results with contractor results.

"The "Scientech" rank was derived from, but is not the same as the rank shown in the contractor's report.

The rank here is the annual worker dose estimate derived by Scientech divided by the smaller number of persons in the range of people over which Scientech indicated that the dose might be distributed.

**APPENDIX 4 TO ATTACHMENT 4: PRELIMINARY RESULTS OF SURVEY OF NRC AND  
AGREEMENT STATE MATERIALS LICENSING AND  
INSPECTION PERSONNEL (under separate cover)**