Technical Amendment to Section 4.1 of US Army June 2007 Dose Assessment for Unloading Bags from a Cargo Ship

The following additional dose assessment was developed to account for the dose from unloading the hold of a ship containing approximately 5000, 1 cubic meter bags and transferring them directly to gondola rail cars. The maximum potential dose to a worker was modeled assuming the following:

1. All bags contain the maximum detected concentration of depleted uranium (DU) at 4.6 Bq/g (134 pCi/g). This assumption is extremely conservative, given the average concentration in the bags is considerably below 1 Bq/g (27 pCi/g).
2. The bags were stowed in a single hold which accommodated an array of bags 50m long, by 20 m wide and 5 meters high. In practice, the bags will be placed in two or more separate holds.
3. The bags were removed, 14 at a time by a single crane and transferred to gondola railcars. In practice, two cranes and two separate stevedoring crews will likely be used during unloading.
4. The time required to load, transfer 14 bags and for the loading jig to return to the hold is 15 minutes.
5. Work time required to off-load the cargo using one crane would be approximately 89 hours –

$$\frac{5000\ \text{bags}}{14\ \text{bags / cycle}} \otimes 0.25\ \text{hr/cycle} = 89.3\ \text{hr.}$$

6. A maximum dose rate was calculated to an individual(s) standing on the bags in the hold. The dose was calculated at one meter above the bags (mid body dose). The individual(s) was assumed to be in the middle of the pile of bags for the total time of unloading (assuming exposure to the maximum dose rate at all times). In practice, two separate crews may be used, and three different shifts of workers, further reducing potential exposure.
7. The mid body dose rates change slightly as each layer of bags is removed. Credit for this is taken by taking the average of the dose rates at the top of each layer and applying the average dose rate for the 89 hours. This assumes each layer takes the same time to unload.

Microshield was used to calculate a dose rate from the center of each layer (see attachment). The average dose rate was calculated at the center of each layer of the stack of bags. Each layer requires approximately 17.75 hours to trans-load. The average dose rate for all 5 levels was determined to be 2.4 microrem/hr. For an 89-hr job this would result in a total dose of 213.6 microrem or approximately one-fifth of one millirem. The International Commission on Radiological Protection classifies one millirem as a trivial dose. Using two cranes and three shifts of different workers, potential exposure would be approximately 35.6 microrem.

Doses to the workers in the rail cars would be significantly less than that to those workers in the hold, assuming the following.

1. Each gondola rail car is smaller than the hold of the ship (approximately 18 m long by 2 m wide by 2 m deep)
2. A rail car will be filled progressively over approximately 107 minutes each (up to 7 individual “lifts”)
3. Workers will be working with smaller quantities of material, with a more limited area of the bags on which they would be standing.

As a result, the potential dose to workers in the rail cars will be significantly less than the dose that workers in the ship’s hold could receive, and which has already been determined to be trivial under the standards of The International Commission on Radiological Protection.