War & Peace Cluster, Summit Program
Fall 2017 – Engl 3550 - Physics section
Physics Assignment 2

Below are some questions which relate to the background information for this cluster. We shall fill in the details later in the fall and winter. For now, concentrate on getting factual information without worrying about explanation.

1. *Health effects and cancer.* How many people in the US will die from cancer per year? What fraction of the total number of deaths per year does this represent?
   a. About 550,000 per year, or about 60 million in total
   b. 20%
   c. http://www.reuters.com/article/newsOne/idUSN1926392720080220

2. *Health effects and nuclear power.* Try to find out how many people have died as a result of the nuclear power industry
   a. There is no definitive answer, only 'best guesses' which are inevitably influenced by politics, so find the range (low to high) of the estimates.
      i. Very few, except in the case of Chernobyl
      ii. http://www.umich.edu/~radinfo/introduction/np-risk.htm
   b. How would you try to decide who (if anyone) has the 'best' estimate?
      i. Reputable sites such as the International Atomic Energy Agency, World Health Organization, etc. Avoid those with a political axe to grind.
   c. Can you find any reason (apart from politics) why any one method of determining the number of deaths might either underestimate the correct result, or might overestimate it?
      i. Impossible to identify individuals. Numbers based on best estimate, which could be too high or too low.
      ii. Not all possible mechanisms have been identified.
      iii. Long term effects not properly understood
      iv. Confusion with competing sources of cancer.
   d. (Harder) If we consider the chances of any one person contracting cancer as a result of radiation exposure as being essentially random, then if the are N cases of cancer the fluctuation should be approximately $\sqrt{N}$. From your answer to question 1, how much of a change in the number of deaths in the US per year from cancer would it take for the change to be statistically significant?
      i. Taking N = 550,000 per year, then $N^{½} = \sqrt{550,000} = 742$. Any number less than this will not show up as anything more than a random fluctuation.

3. *Nuclear power generation.* How many nuclear power plants operate within California? How many within the United States? What percentage of the US electricity is generated by nuclear power plants? (Note: a plant is a site with one or more reactors. The question asks for the number of sites, not the number of reactors.)
   a. California – 1, Diablo Canyon and that is due to close by 2025

b. US – 65 plants, containing 100+ reactors
c. About 20% (http://www.world-nuclear.org/info/inf41.html)

4. *Accidents related to nuclear power generation.* What was the most serious accident involving nuclear power plants worldwide? Where was it and when? How many people were killed? How many were affected? What was the most serious accident involving nuclear power plants in the US? Where was it and when? How many people were killed? How many were affected?
   a. Worldwide - Chernobyl, Ukraine, 1986
   b. 31 in a few days, rising to 56 or so in a few weeks (http://www.chernobyl.info/)
   c. 4000 extra cancer deaths expected in next few decades (http://www.who.int/mediacentre/factsheets/fs303/en/index.html)
   d. US - Three Mile Island, PA, 1979
   e. No known deaths or health effects

5. *Nuclear weapons*
   a. What was the date, time, and location of the world's first detonation of a nuclear device? July 16th 1945, New Mexico
   b. What was the date, time, and location of the world's first detonation of a nuclear bomb as a weapon? Aug 6th 1945, Hiroshima, Japan
   c. What was the date, time, and location of the world's first detonation of a thermonuclear device (H bomb)? November 2nd 1952, Enewetak Island

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6. *Accidents related to nuclear weapons.* The following are all incidents involving the US arsenal of weapons. In each case find out when it happened, where, and what the consequences were.
   a. Palomares
      Crash of a B-52G bomber KC-135 tanker during mid-air refuelling off the coast of Spain. The KC-135 was completely destroyed when its fuel load ignited, killing all four crew members. The B-52G broke apart, killing three of the seven crew members aboard. Of the four Mk28 type hydrogen bombs the B-52G carried three were found on land near the small fishing village of Palomares. The non-nuclear explosives in two of the weapons detonated upon impacting the ground, resulting in the contamination of a 0.78 square mile area by radioactive plutonium (akin to a dirty bomb explosion). The fourth, which fell into the Mediterranean Sea, was recovered intact after a 2½ month-long search.
      (http://en.wikipedia.org/wiki/1966_Palomares_B-52_crash).
   b. Tybee Island
      B-47 crash (February 5, 1958) in which the United States Air Force lost a hydrogen bomb in the waters off Tybee Island near Savannah, Georgia, USA. The bomb was jettisoned to save the aircrew during a practice exercise after the B-47 bomber carrying it collided in midair with an F-86 fighter plane. Following several unsuccessful searches, it was presumed lost somewhere in Wassaw Sound off the shores of Tybee Island. A study concluded that the bomb does not pose a significant threat. (http://en.wikipedia.org/wiki/1958_Tybee_Island_B-47_crash)
   c. Thule
   d. An accident on January 21, 1968 involving a United States Air Force (USAF) B-52 bomber. The aircraft was carrying four hydrogen bombs when a cabin fire forced the crew to abandon the aircraft before they could carry out an emergency landing. The bomber crashed onto sea ice near Thule Air Base in North Star Bay, Greenland, causing the nuclear payload to rupture and disperse, which resulted in widespread radioactive contamination. Original conclusions confirmed that the exposures were not significant.
      (http://en.wikipedia.org/wiki/1968_Thule_Air_Base_B-52_crash,
      http://airforcemedicine.afms.mil/latestnews/palomares.htm)