Files

March 18, 1961.

Clifford K. Beck, Assistant Director
Nuclear Facilities Safety

INFORMAL DISCUSSIONS WITH U. K. AND CANADIAN OFFICIALS ON REACTOR SITING

1. Present: Dr. Stuart McLean
Mr. Meyer
Dr. W. G. Marley (part time)
Dr. George Laurence (from Canada)
Clifford Beck (AEC)
Dr. F. K. Farmer

2. The British, mainly Dr. Farmer, discussed their approach to the problem of reactor siting. It consists essentially of three steps:

(a) Evaluative rating of reactor sites from an environmental viewpoint. This has been done for all potential reactor locations in England. Each location is given a rating of its proportional suitability as a reactor site. The procedure is discussed further below.

(b) Evaluation of the Reactor: The amount of fission products present in the reactor, I^{131} is the crucial isotope, is considered and the various devices are evaluated by which the amount which might potentially be released to the atmosphere is reduced to tolerance level. The nature of the reactor, its safeguard features and its safety devices are considered and an eventual "fission product release number" is arrived at for each reactor.

(c) The "release number" for a reactor is then compared to the site rating, and a decision is made about the compatibility of the two. The rules for this matching are not very definite.

3. A basic feature in the British system is the use of a weighting factor for the influence of population on the environmental rating of a reactor. The weighting factor

(continued)

A/236 pt 100

is derived from the basic assumption that injury to people is [redacted] proportional to the square of the exposure dose. Thus, people near a reactor who would receive the higher exposure doses in case of an accident, count a great deal more heavily in the rating of a site than do people further out where the doses could be lower.

4. The British conclude because of the probabilities of various isotopes being released from a reactor that inhalation of I^{131} is the controlling factor in consideration of exposure doses in the site selection problem.

5. Meteorology: The British divide all weather conditions into seven categories, labeled A, B, C....G (a scheme developed by Pascal, described in the general Meteorology Journal, March 1961). Condition F (which exists in England for 10 to 22 percent of time) is used for site evaluation. Condition G, the worst, exists in England 3% of time. Condition F is essentially similar to the weather condition used in the U. S.'s proposed site criteria except 2m/sec wind speed is used, instead of the U. S. 1m/sec. The British also allow a factor of 1/10 reduction in area concentrations because of wind variation; the U. S. guide gives no credit for this effect. The British assumes an 0.1 cm/sec deposition velocity; the U. S. guide allows no credit for deposition.

6. Exposure Doses versus Air Concentration: British doses for given atmospheric concentrations come out slightly lower than U. S. values in table 3 of the proposed guides because the British consider additional radioactive decay while iodine is in the blood stream and before deposition in the thyroid.

7. Injury versus Dose: The U. S. assumes that injury is linearly proportional to exposure dose. The British assumes that injury is inversely proportional to the square of exposure dose. They refer to the work of Simpson and Hipplemann, and Simpson and Singer in developing a population rating for a site. The British proceed as follows:

(continued)

(a) People within one mile must be evacuable but otherwise are not counted.

(b) The "worst" 30° sector is chosen; segments are marked off at one mile intervals in this sector.

(c) The number of people in each one mile segment of the sector is multiplied by a weighting factor which combines exposure doses and inverse square proportionality of injury to the exposure dose.

(d) Two examples which are arrived at by these procedures at the same rating are: (1) a site in which relatively few people live within the first 11 miles but a city of 400,000 is located at 12 miles; (2) a site in which 4,000 people are about 1-1/2 miles from the reactor and 11,000 in the next 11 miles.

(e) The British assumes that genetic dose can be neglected, for these reasons:

(1) inhaled iodine or bone seeking isotopes which locates in the thyroid or bones are not relevant to the genetic problem;

(2) whole body external gamma radiation doses are only large enough to have genetic considerations in areas near the reactor where people are considered evacuable;

(3) people who might get genetic exposures from deposited radioactivity can be re-located.

8. Reactor evaluation consists in arriving at a fission product "release number" for each reactor, i.e. the number of curies which, after all safeguards have been duly evaluated, might be released to the environment in case of a major reactor catastrophe.

10^7 curies of I^{131} are in a large reactor. The characteristics of the reactor, the nature of the building, filtration or spray equipment, and other features are considered which might lead to an estimate of the amount of this inventory which might reach the environment in case of accident (a

(continued)

stainless steel oxide fuel is given a factor of 10 credit as compared to a reactor having metal fuel).

9. (5×10^3 curies of iodine release to the atmosphere under British assumptions gives 300 rem to the thyroid of children at 1-1/2 miles; 25 rem at 12 miles).

10. The fission products "release number" arrived at by the evaluation of the reactor is then compared to the site rating number previously described in arriving at a final decision and the suitability of a given site for a given reactor. The process by which this comparison is made was not described.

11. The British believes that iodine absorbed on to particles larger than 10μ size does not constitute an exposure hazard. They believe that less than 10% of released iodine will be associated with the dangerous particles smaller than 10μ.

12. British experiments indicate that halogen is only released from molten metal if oxygen is used to replace the halogen.

13. British experiments with prevention of radioactive iodine uptake in the thyroid by prior dosage of a person with pills of potassium iodide (non-radioactive) indicate that if 300 mg is taken by an adult within six hours of exposure the uptake is reduced by a factor of two; if the iodine is taken within 2 hours of exposure the uptake is reduced by a factor of 10.

14. If equal percentages of iodine and strontium should be released from the reactor, the iodine would be 2-1/2 times more damaging than the strontium.