D. MAXIMUM REACTOR COOLANT ACTIVITY*

Specification

1. The total specific activity of the reactor coolant, excluding tritium, due to nuclides with half-lives of more than 30 minutes, shall not exceed $60/\bar{E}$ μCi/cc, whenever the reactor is critical or the average reactor coolant temperature is greater than 500°F. ($\bar{E}$ is the weighted average of the beta and gamma energies per disintegration in Mev.)

Basis

The specified limit provides protection to the public against the potential release of reactor coolant activity to the atmosphere, as demonstrated by the following analysis of a steam generator tube rupture accident. [1]

Rupture of a steam generator tube would allow a portion of the reactor coolant activity to enter the secondary system. The major portion of this activity is noble gases which are diverted to the containment within a few seconds after the air ejector monitors high activity signal. The activity release to atmosphere is not significant.

In the event the air ejector discharge is not diverted to the containment, a portion of the reactor coolant noble gas activity would be released to the atmosphere through the secondary system. Activity could continue to be released until the operator would reduce the primary system pressure below the lowest setpoint of the secondary relief valves and could isolate the faulty steam generator. The worst credible set of circumstances is considered to be a double-ended break of a single tube, with the air ejector discharging to the atmosphere, followed by isolation of the faulty steam generator by the operator within 45 minutes after the event. During that time approximately one-sixth of the total reactor coolant could be released to the Steam and Feedwater System.

The limiting offsite dose is the whole-body dose resulting from immersion in the cloud containing the released activity. Radiation would include both gamma and beta radiation. The gamma dose is dependent on the finite size and configuration of the cloud. However, the analysis will employ the simple model of a semi-infinite cloud, which gives an upper limit to the potential gamma dose. The semi-infinite cloud model is

* See Specification 3.4 for activity limits on the secondary side.

applicable to the beta dose, because of the short range of beta radiation in air. The effectiveness of clothing as shielding against beta radiation is neglected and therefore the analysis model also gives an upper limit to the potential beta dose.

The combined gamma and beta dose from a semi-infinite cloud is given by:

Dose (rem) = $1/2\ (\bar{E} \bullet A \bullet V \bullet X/Q\ (3.7 \times 10^{10}) \bullet (1.33 \times 10^{-11}))$

Where: $\bar{E}$ = weighted average energy of betas and gammas per disintegration (Mev/dis),

A = primary coolant activity (micro Ci/cc),

V = primary coolant volume released to the secondary side (66.75 m^3),

X/Q = 7.5×10^{-4} sec/m^3, the 0-2 hr. dispersion coefficient at the site boundary,

3.7×10^{10} dis/sec - Ci, and

1.33×10^{-11} rem/Mev/m^3.

The resulting dose is 0.75 rem at the site boundary when A is equal to $60/\bar{E}$, which is the expression used in this specification. This dose is less than 10 percent of the guideline values of 10 CFR 100 (i.e., less than 2.5 rem whole body).

If the air ejector discharge is diverted to the containment, the only activity released to atmosphere is that contained in the steam flow to the turbine gland seal (5000 lb/hr). For this case the activity release to atmosphere during the 45-minute period would be 1.1% of the values given above. It is concluded that a tube rupture accident would not result in significant radiation exposure.

The basis for the 500°F temperature contained in the specification is that saturation pressure corresponding to 500°F, 680.8 psia is well below the pressure at which the atmospheric relief valves on the secondary side would be actuated.

Calculations required to determine $\bar{E}$ will consist of the following:

1. Quantitative measurement in units of μCi/cc of radionuclides with half-lives longer than 30 minutes making up at least 95% of the total activity in the primary coolant.

2. A determination of the beta and gamma decay energy per disintegration of each nuclide determined in (1) above by applying known decay energies and schemes. (Table of Isotopes, Sixth Edition, March 1968).

3. A calculation of $\bar{E}$ by appropriate weighting of each nuclide's beta and gamma energy with its concentration as determined in (1) above.

References

(1) UFSAR Section 14.2.4