1. Introduction

The assessment of radiological consequences resulting from accidental releases of a nuclear installation is based on the calculation of atmospheric transport of radionuclides. An intercomparison of the calculation procedure in Germany and France shows differences characterized as follows:

- the relevant guideline in Germany recommends usage of the Gaussian-plume-model and dispersion parameters derived from the dispersion experiments at the research centers of Jülich and Karlsruhe /BMU, 1989/

- official guidelines to calculate the radiological consequences do not exist in France. At the Institut de Protection et de Surete Nucleaire (IPSN) radiological consequence assessment can be done by using three different types of Gaussian based models (nomograms, plume- or puff-model), each of them with the dispersion parameters based on Doury (1976).

Under the mandate of the German-French Commission for nuclear safety aspects (DFK), an intercomparison of these two methods has been carried out in 1987. Source distances up to 20 km and a continuous release have been considered. The results revealed differences which could be attributed to the different parametrizations of the dispersion parameters. In view to an accident at a nuclear power plant located near the French-German border, the application of both methods could yield different emergency actions in both countries, a situation which is scientifically and politically unacceptable. Therefore the advisory board of the DFK gave another mandate to review and update the methodology for calculation of atmospheric transport of radionuclides to come up with a calcu-
lation scheme for emergency actions which should be used in both countries.

In the following chapters the activities of a working group are summarized, starting with a description of different turbulence parameterization methods for Gaussian puff models. The results of the proposed models have been compared to different dispersion experiments as well as to calculations with the methods used in the past.

2. Update of the Modelling concepts

In october 1987 a workshop of the DFK (1988) dealt with a discussion of appropriate methods for calculating atmospheric dispersion for emergency actions focusing on source distances up to 20 km. The French and German participants agreed on the fact that a Gaussian-puff-model should be used to calculate the atmospheric dispersion following a nuclear accident. Different ways to determine the diffusion parameters have been discussed. A spectral approach has been favoured by the French side, while a combined similarity and convective scaling approach has been given preference by the German participants.

2.1 French approach

The French approach is based on considerations upon the turbulence spectra and relations between the spectra and the standard-deviations. Assuming the emission of successive puffs that we observe after a travel time \( t \) and during a sampling time \( T \), the standard-deviation of the distribution of a pollutant is a combination of two phenomena: the relative diffusion of the puffs around their centers of mass, noted \( \sigma_b \), and the dispersion of the centers of mass of the puffs, noted \( \sigma_c \). The total standard-deviation \( \sigma \) is the result of these two phenomena which are assumed to be uncorrelated:

\[
\sigma^2 = \sigma_b^2 + \sigma_c^2
\]

(1)

The relative diffusion has been studied by Smith and Hay (1961):

\[
\frac{d\sigma_b^2}{dt} = 4/3 \int_0^\infty F_E(n) \cdot \text{sinc}(2\pi nt/\beta) \cdot (1-\exp(-(2\pi n\sigma_b/u)^2)) \cdot dt \cdot dn
\]

(2)

\( F_E(n) \) : Eulerian turbulence spectrum in terms of frequency \( n \)
\( \beta \) : variable relating the Lagrangian values to the Eulerian values where \( \text{sinc}(a) = \sin(a)/a \)
\( u \) : characteristic velocity of the scale of turbulence considered

The second type of diffusion is based on Taylor's formulation (1921):

\[
\sigma_c^2 = \int_0^\infty F_E(n) \cdot \text{sinc}^2(\pi nt/\beta) \cdot (1-\text{sinc}^2(\pi nT)) \cdot \exp(-(2\pi n\sigma_b/u)^2) \cdot dn
\]

(3)

In order to solve the equations of \( \sigma_b \) and \( \sigma_c \), it is necessary to choose \( F_E(n) \) and \( \beta \). The turbulence spectrum is consi-