Capability of Vinatom in assessing the dispersion of radioactive material in air

Kick-off Meeting for ASEAN Network on Nuclear Power Safety Research and the 2nd ASEAN Workshop on Nuclear Power Safety Research

Nguyen Hao Quang

Vietnam Atomic Energy Institute (VINATOM), MOST, Vietnam

Content

- Capability of Vinatom in assessing the dispersion of radioactive material in air

- The preliminary results of benchmark problem on the nuclear accident consequence assessment

Capability of Vinatom in assessing the dispersion of radioactive material in air

- Models are used by Vinatom to assess the dispersion of radioactive material in air
- Computer codes are used by Vinatom

Capability of Vinatom in assessing the dispersion of radioactive material in air

Atmospheric dispersion models

- Gaussian diffusion model

$$\chi = \frac{Q'}{2\pi u \sigma_y \sigma_z} \exp\left[-\frac{1}{2}\left(\frac{y^2}{\sigma_y^2} + \frac{z^2}{\sigma_z^2}\right)\right]$$

u – wind speed in the x-direction

Q’ – amount of contaminant released per unit time

σ_y, σ_z- standard deviation of Gaussian distribution according to y-axis, z-axis respectively

χ - concentration of contaminant

Capability of Vinatom in assessing the dispersion of radioactive material in air

Atmospheric dispersion models

- Sector averaging

$$\chi_s(x) = \sum_{p=1}^{N_p} \sum_{r=1}^{N_r} \frac{N_s . f_{prs} . Q'}{\sqrt{2} . \pi^{3/2} . x . u_r . \sigma_{zp}(x)} \exp\{-\frac{1}{2}\left[\frac{h_p}{\sigma_{zp}(x)^2}\right]\}$$

$\chi_s(x)$ – ground-level air concentration of contaminant in wind direction *s* at downwind distance *x*

N_p – number of atmospheric stability classes

N_r – number of wind speed classes

f_{prs} – joint frequency of occurrence of atmospheric stability class *p*, wind speed class *r*, and wind direction *s*

Q' – release rate of contaminant per unit time

u_r – mean wind speed associated with wind speed category *r*

$\sigma_{zp}(x)$ – the specific value of σ_z associated with stability class *p* and downwind distance *x*

Capability of Vinatom in assessing the dispersion of radioactive material in air

Computer codes

- NRCDose72
- PAVAN
- HotSpot 3.0
- RASCAL 4.2

The preliminary results of benchmark problem on the nuclear accident consequence assessment

- Benchmark problem
- Preliminary results

The preliminary results of benchmark problem on the nuclear accident consequence assessment

Benchmark problem

- **Source term**
  - Cs-137 with activity of 3.2E16 Bq
  - I-131 with activity of 2.4E15 Bq
- **Duration of release**
  - 24 hours
- **Duration of accident**
  - 30 days

The preliminary results of benchmark problem on the nuclear accident consequence assessment

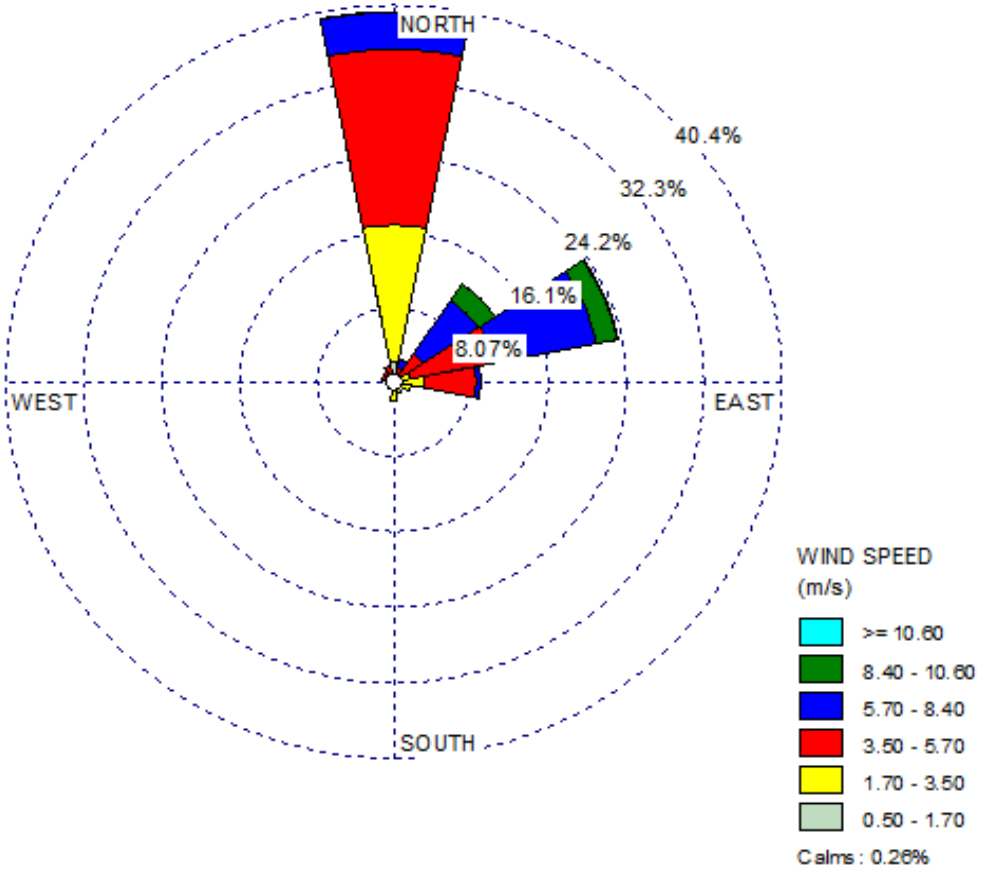
Benchmark problem

- **Meteorological data**
  - Hourly meteorological data for 1 year at Ninh Thuan and Fangchenggang, which are provided by Vinatom. The meteorological data includes: date; wind direction; wind speed; stability; rainfall
- **Estimation of the nuclear accident consequence**

The preliminary results of benchmark problem on the nuclear accident consequence assessment

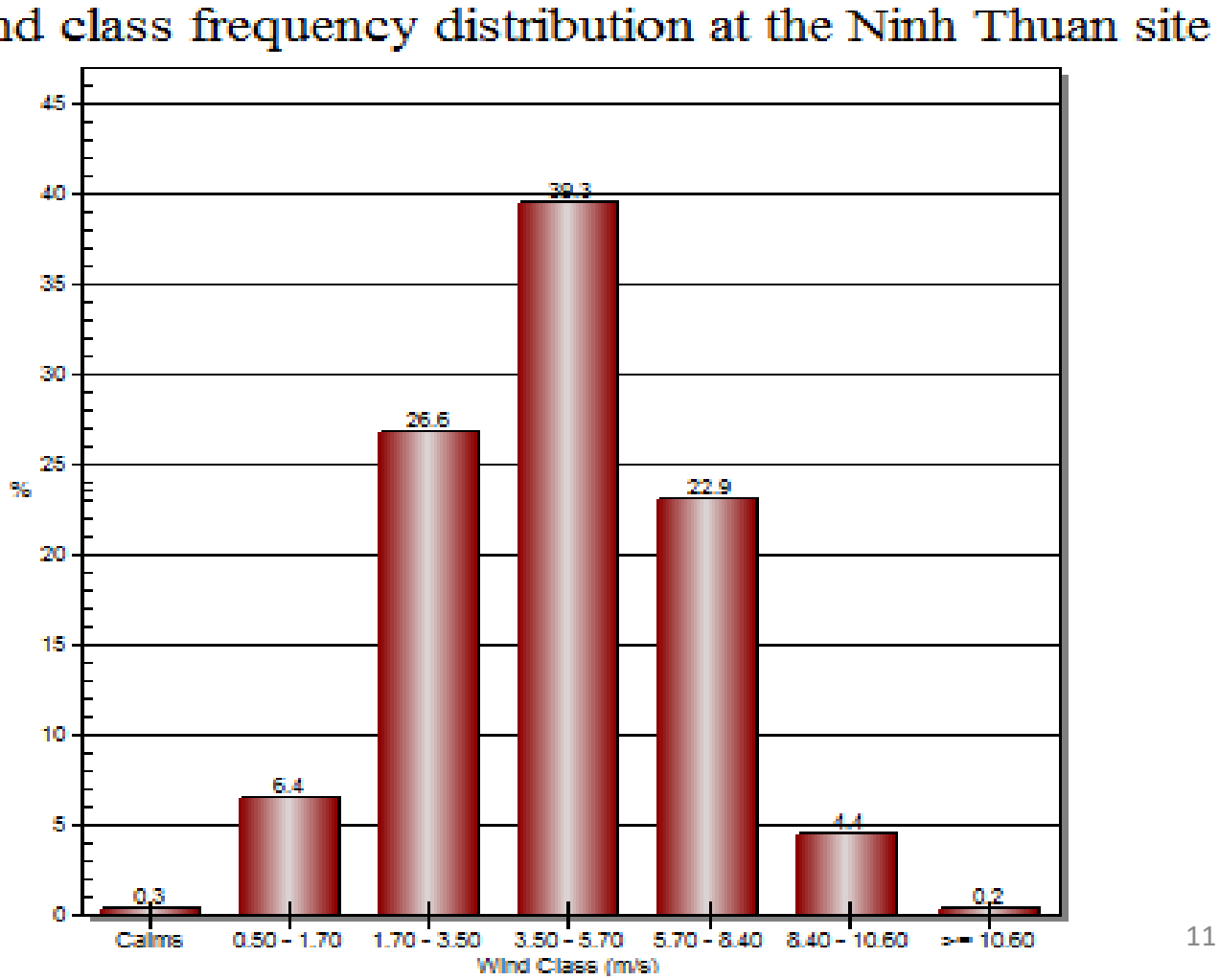
Preliminary results

Wind rose at the Ninh Thuan site



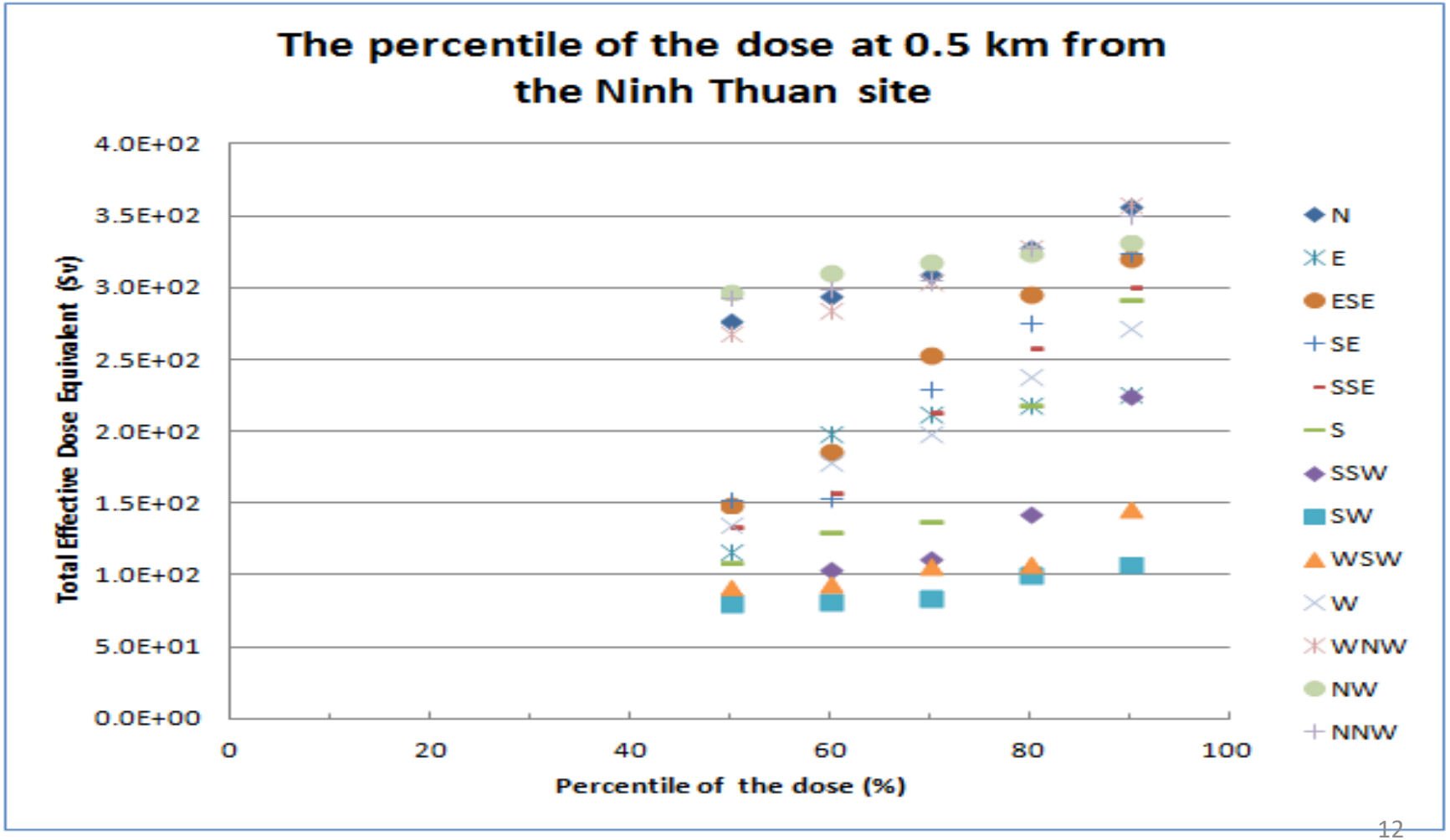
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results

The components contribute into the TEDE

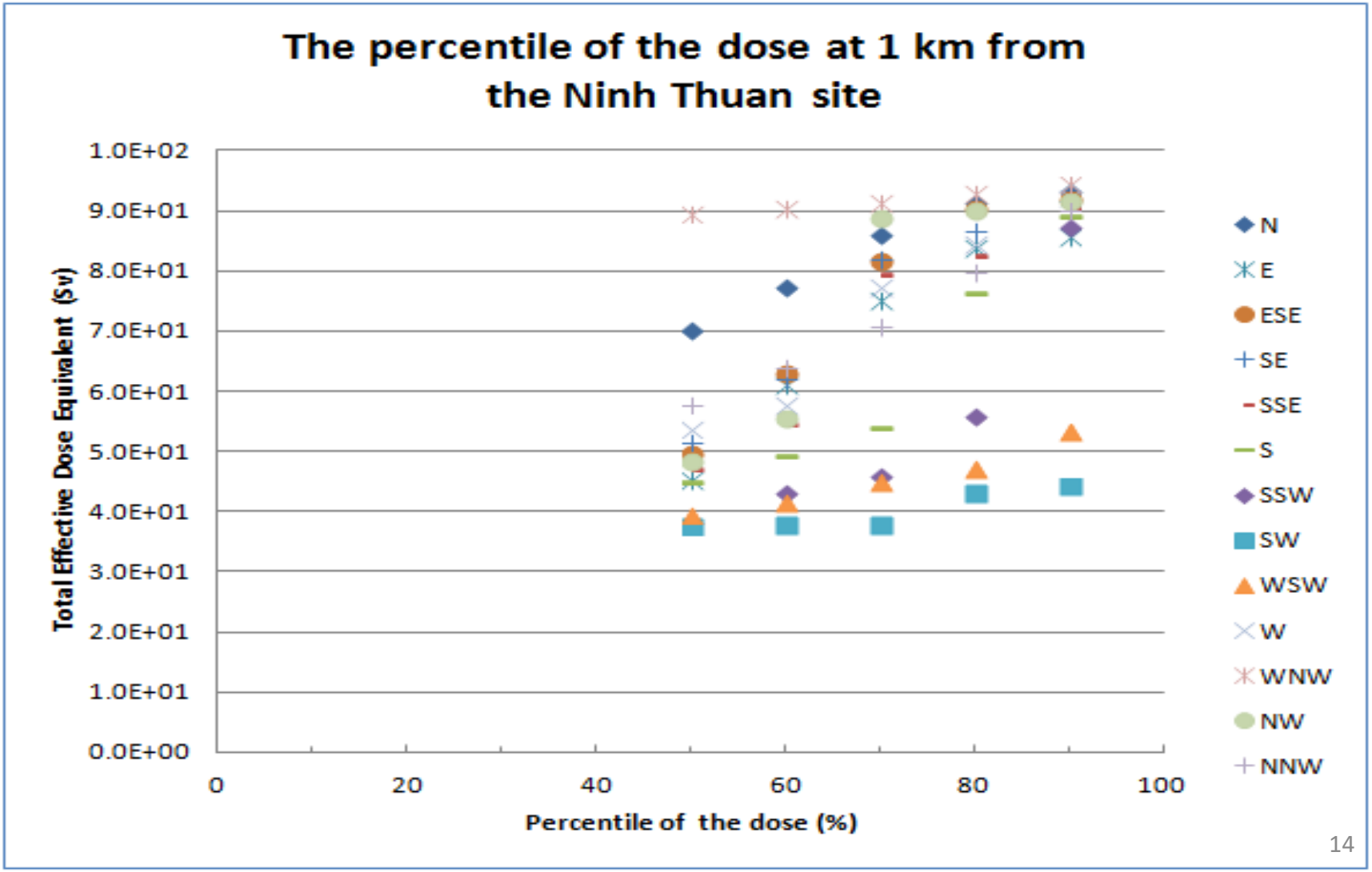
- Inhalation
- Submersion
- Ground shine
- Resuspension

In the case wind speed of 1 m/s; stability of D; distance of 0.5 km

Inhalation: 7.13E+00 (Plume Passage) (Sv)
Submersion: 6.60E-02 (Plume Passage) (Sv)
Ground Shine: 2.70E+02 (Sv)
Resuspension: 5.97E+00 (Sv)
Total: 2.8E+02 (Sv)

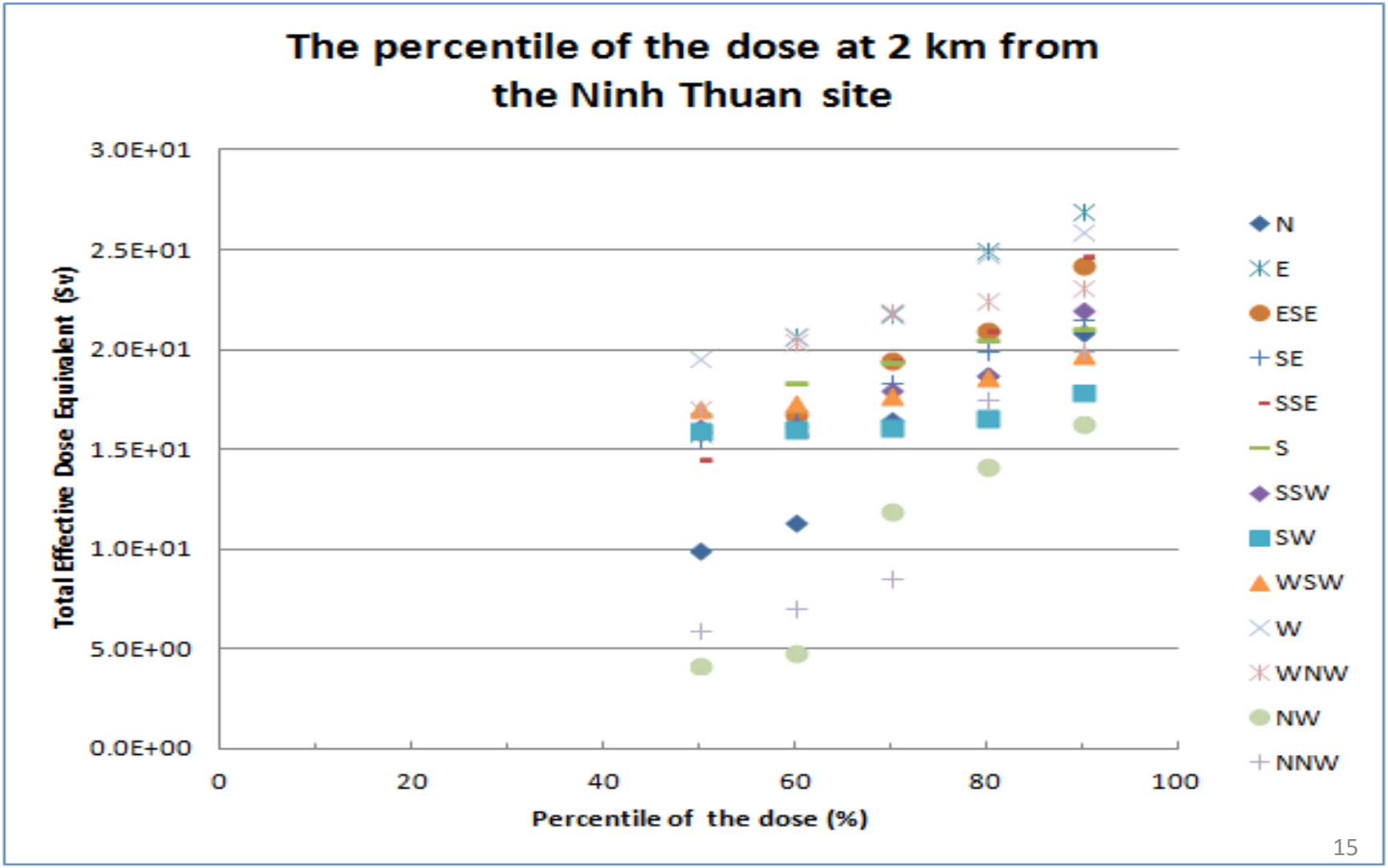
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



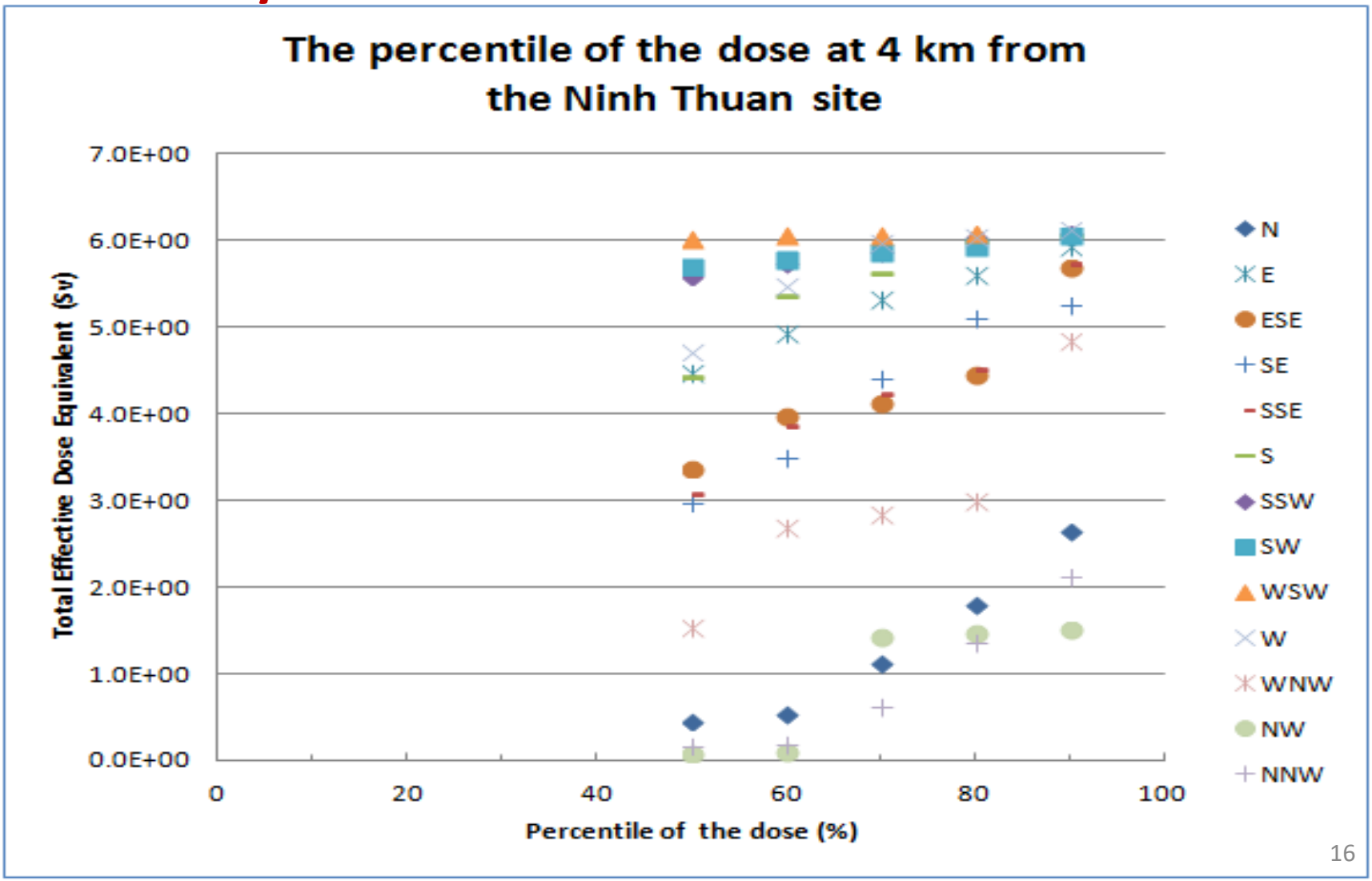
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



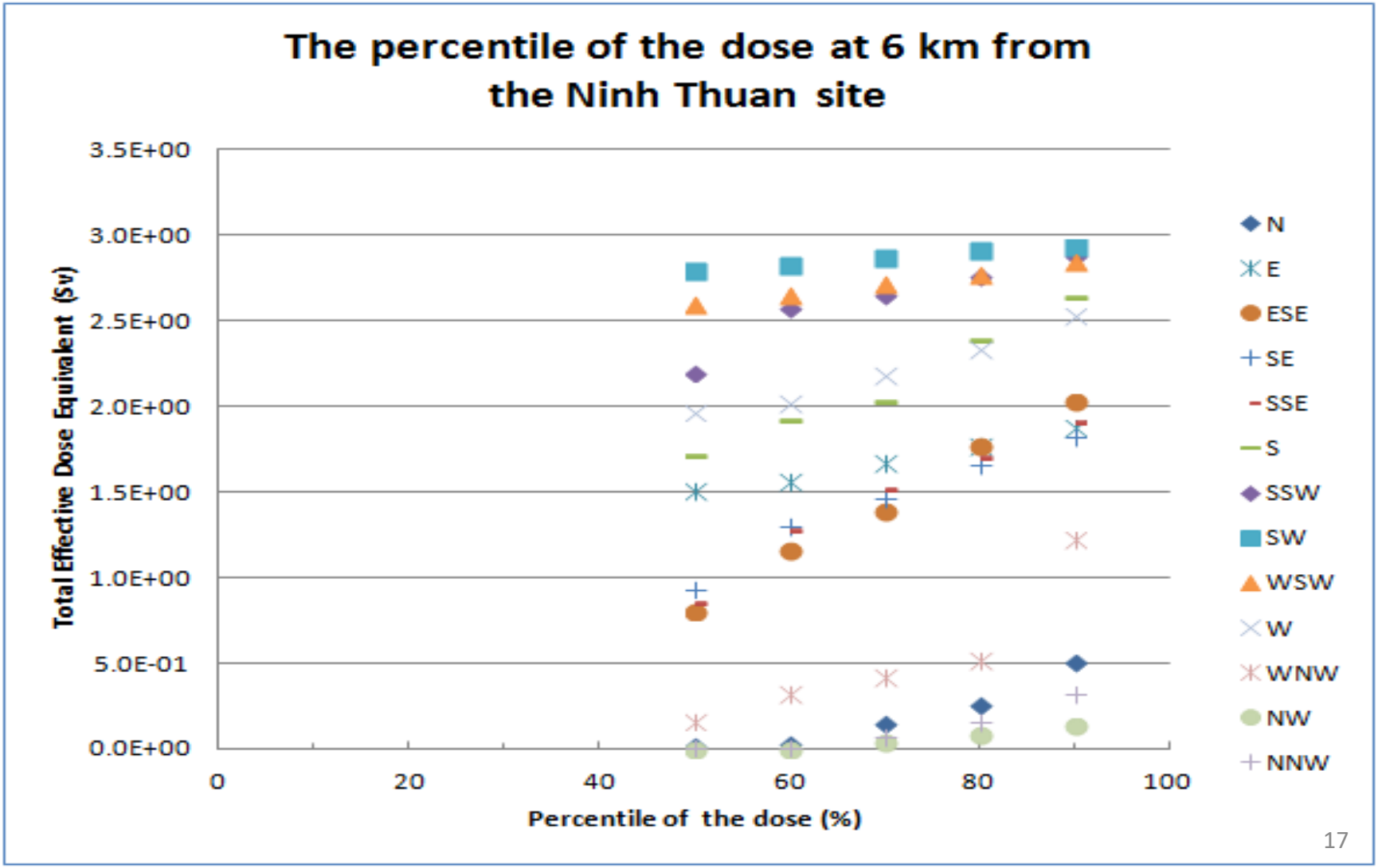
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



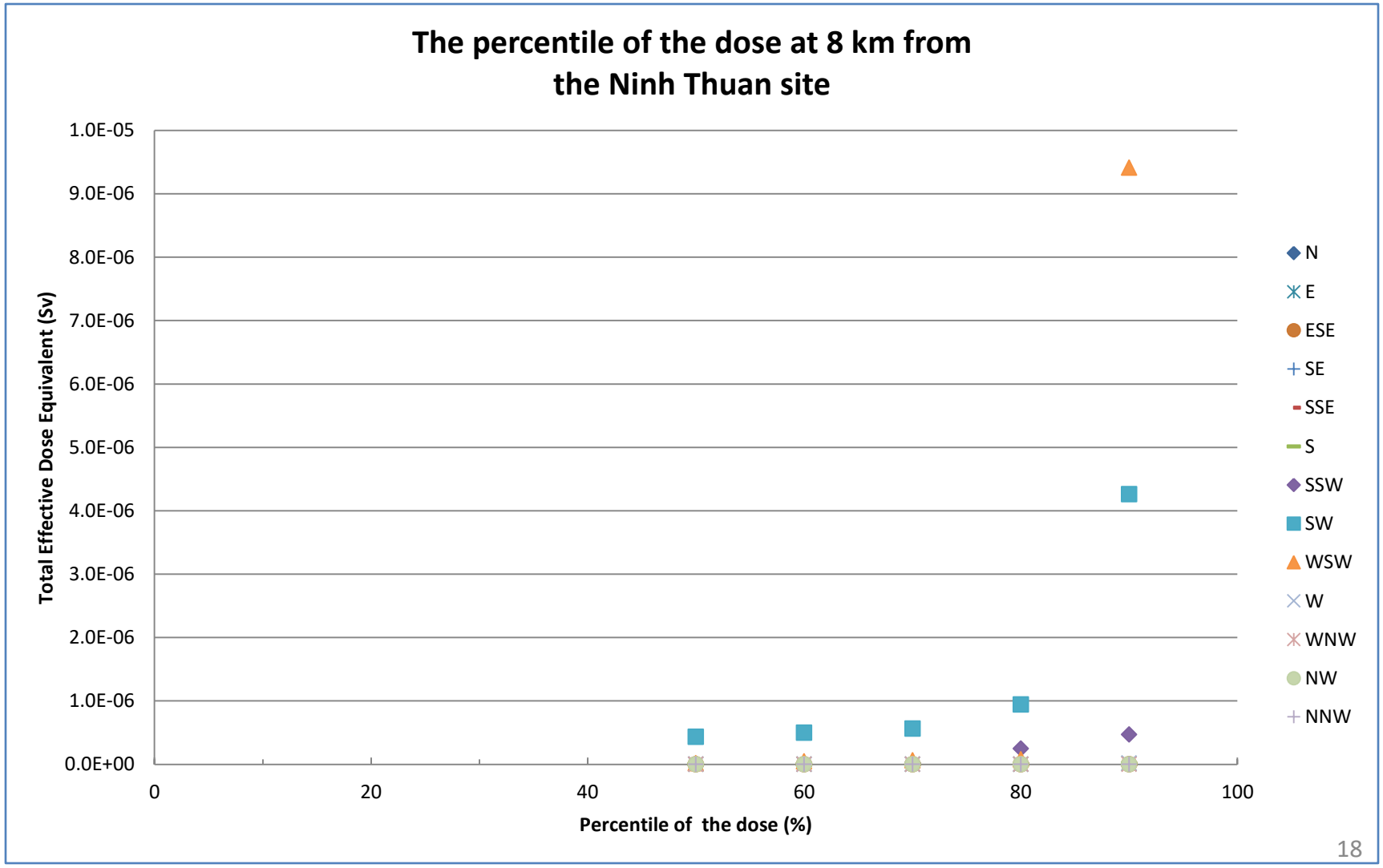
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



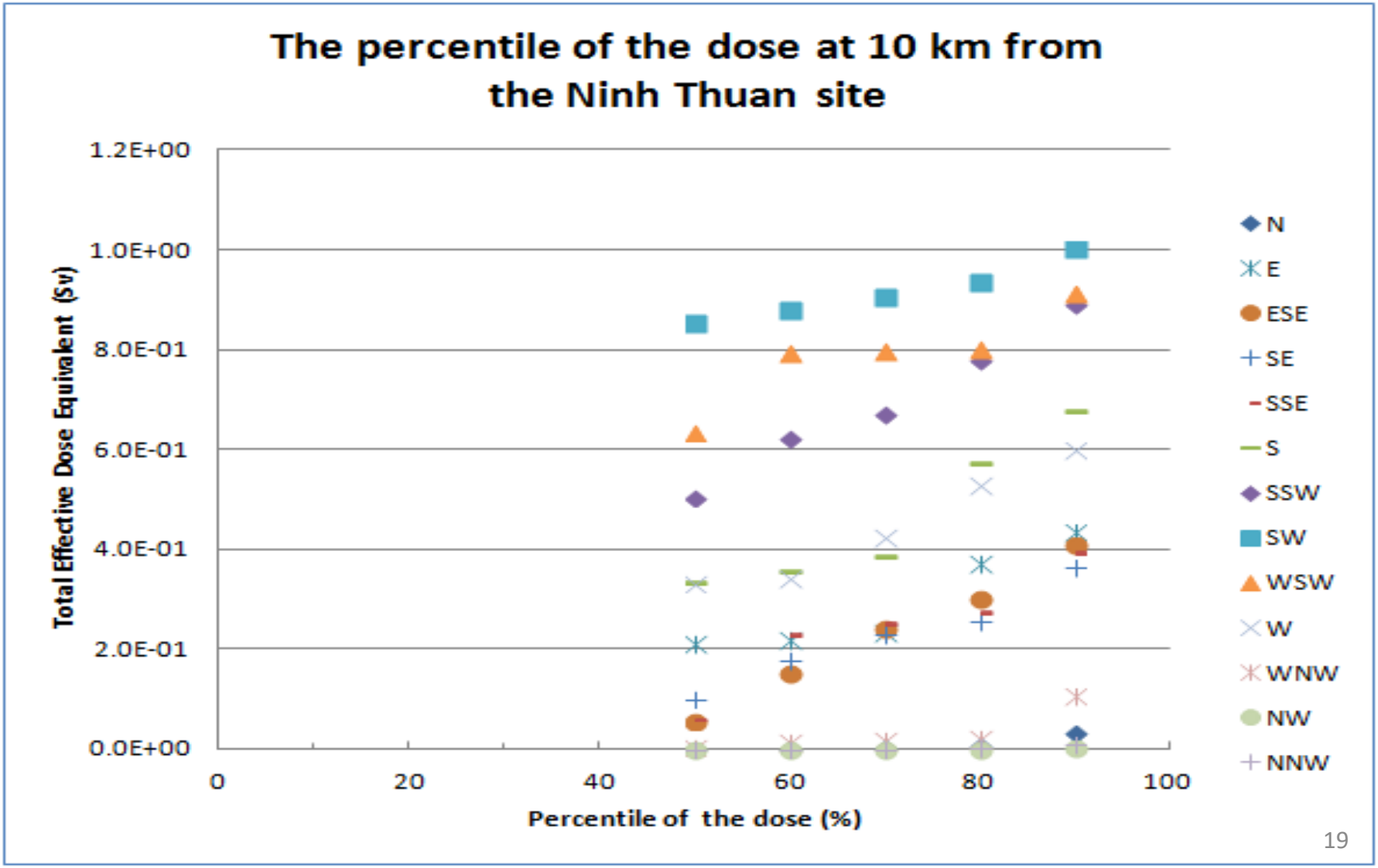
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



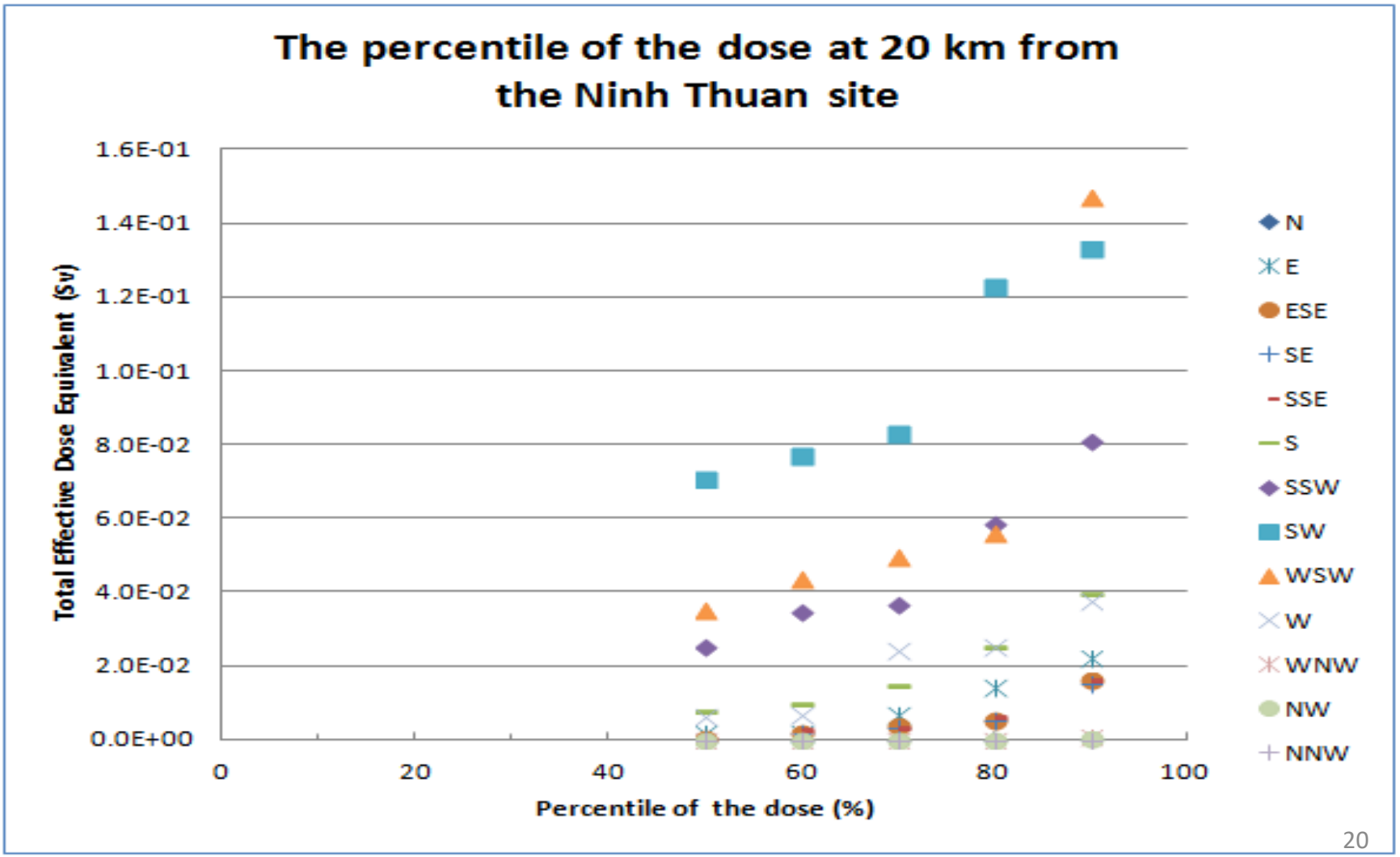
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



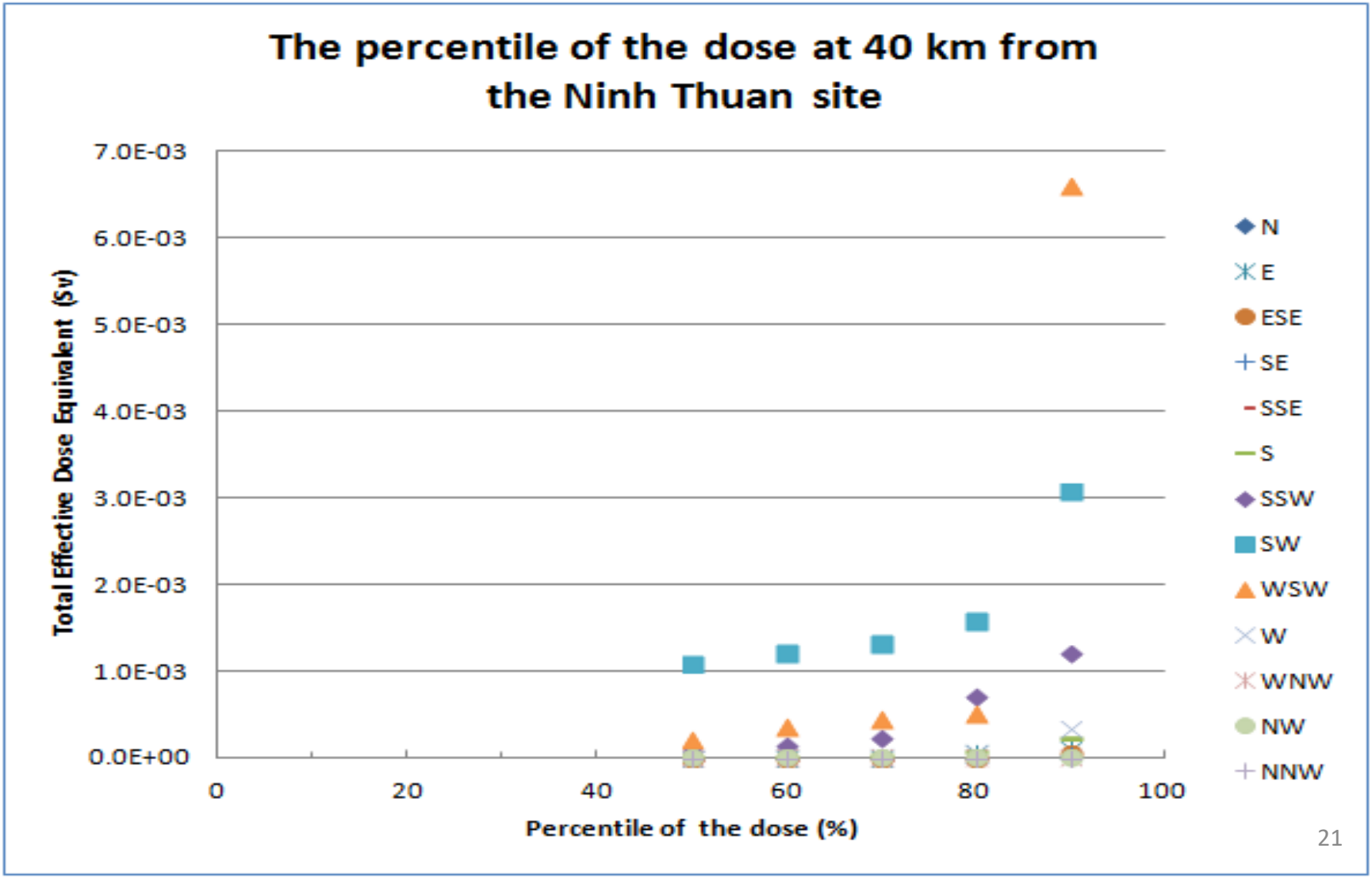
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



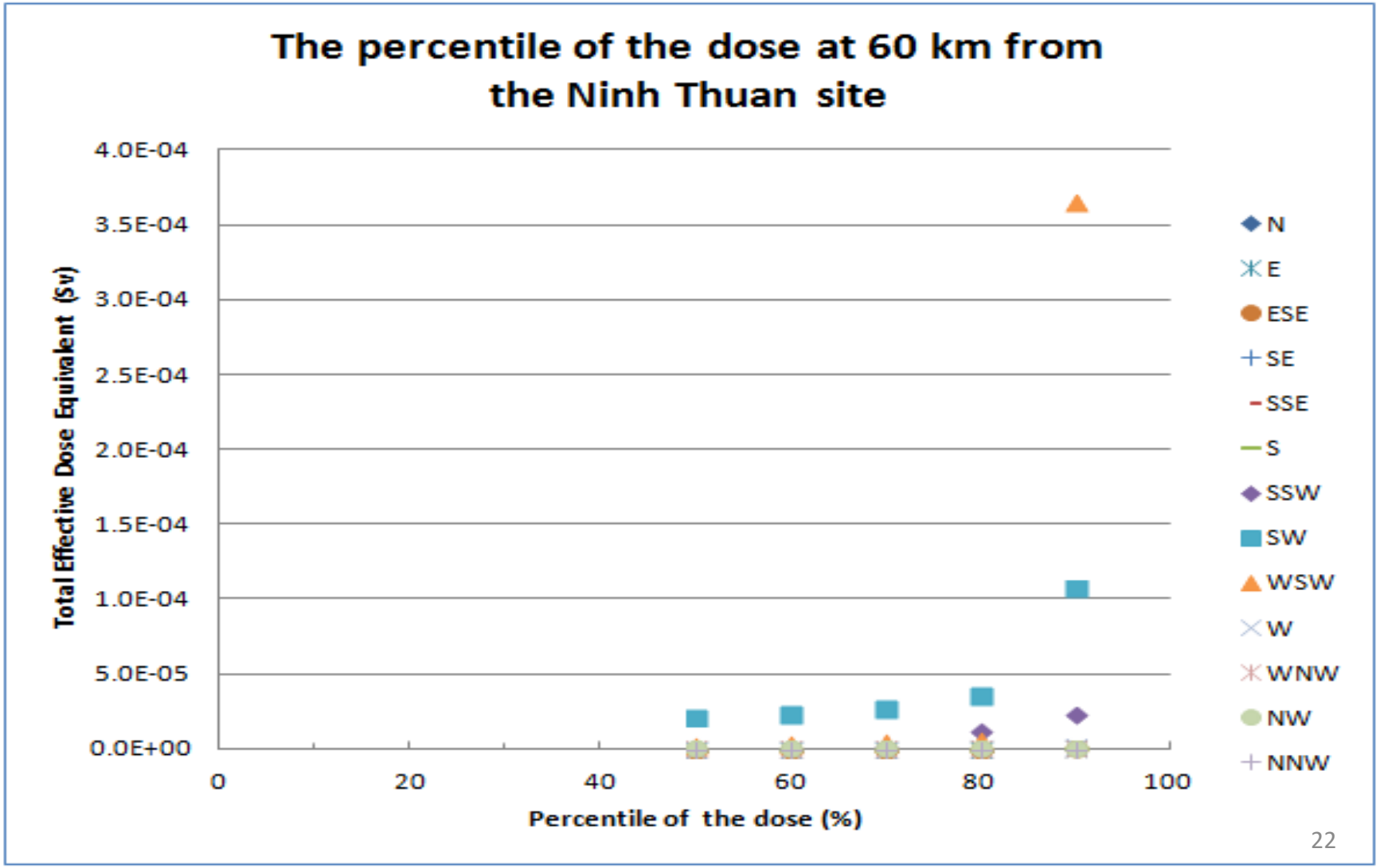
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



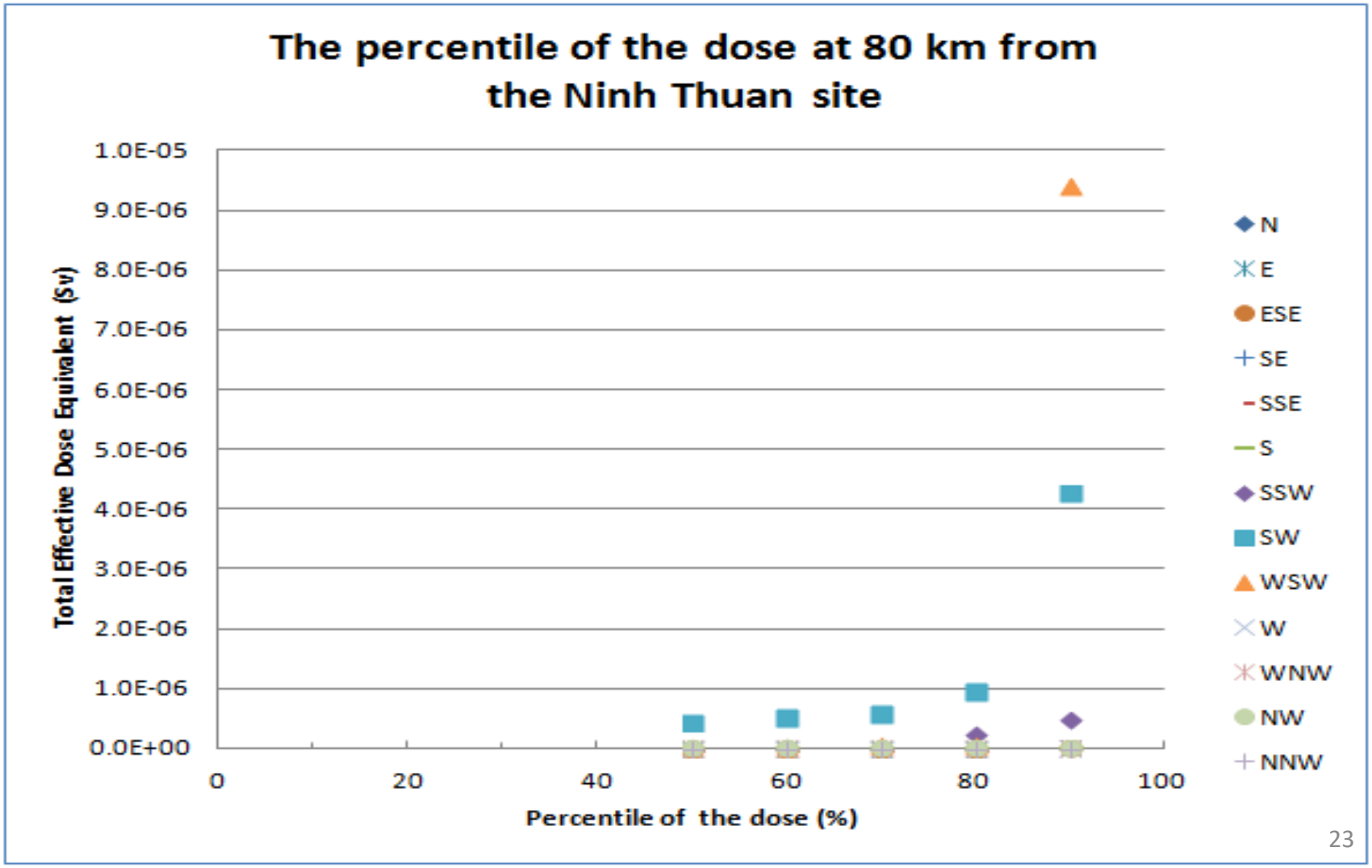
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



The preliminary results of benchmark problem on the nuclear accident consequence assessment

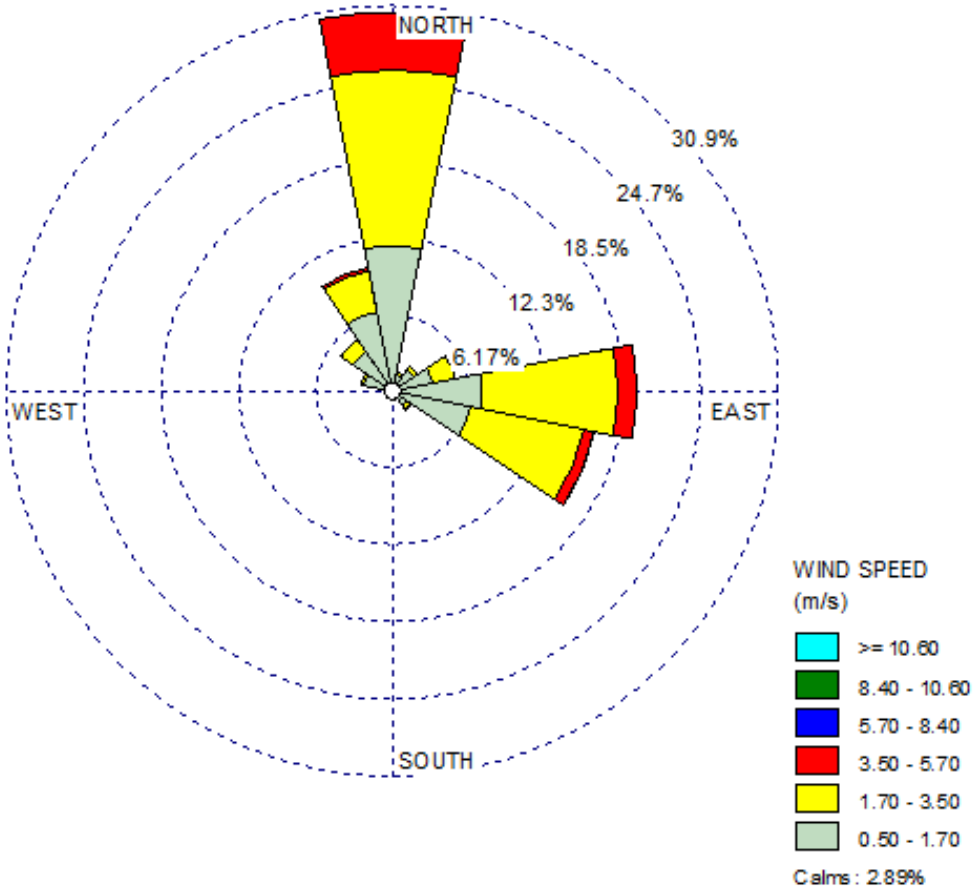
Preliminary results



The preliminary results of benchmark problem on the nuclear accident consequence assessment

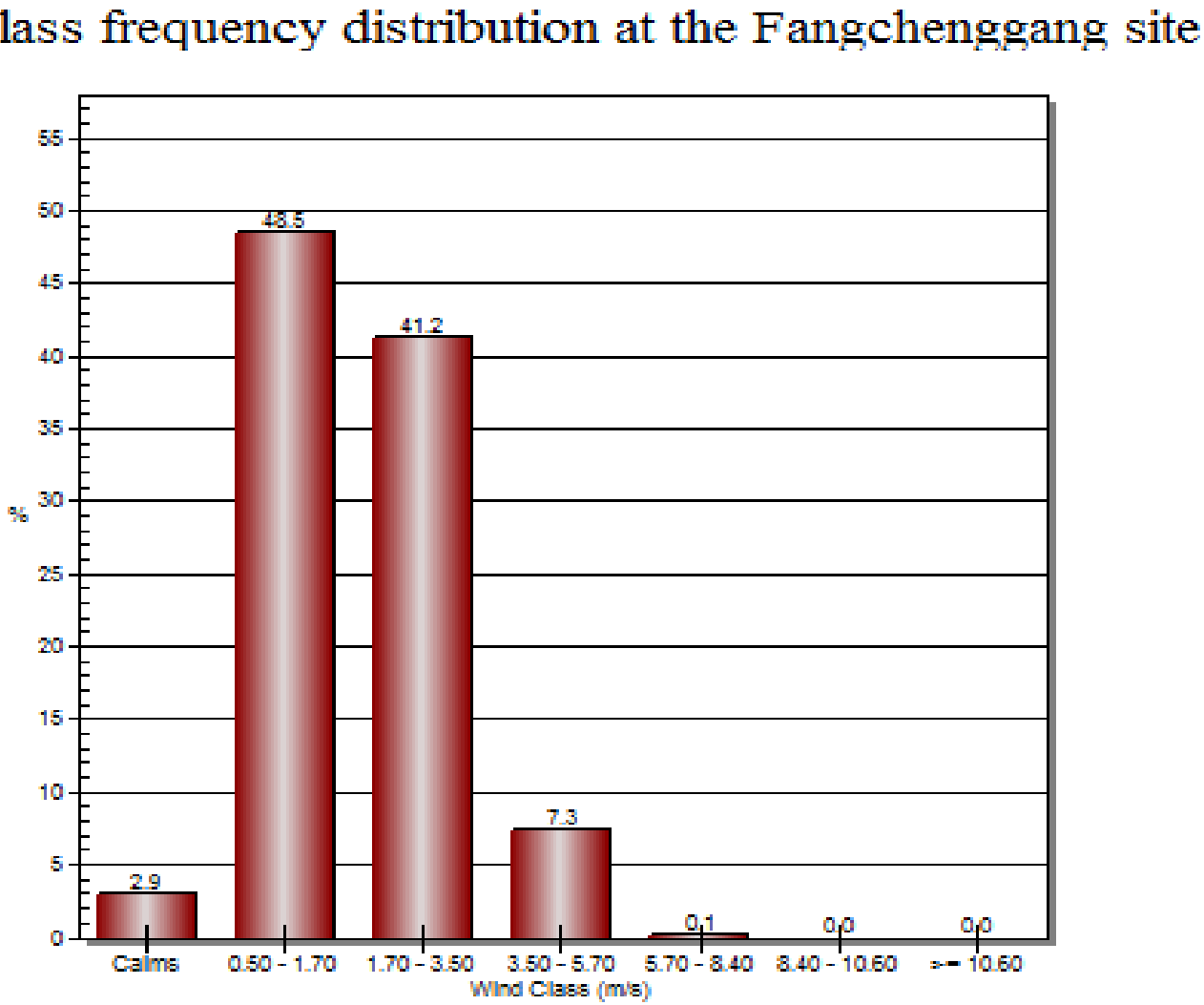
Preliminary results

Wind rose at the Fangchenggang site



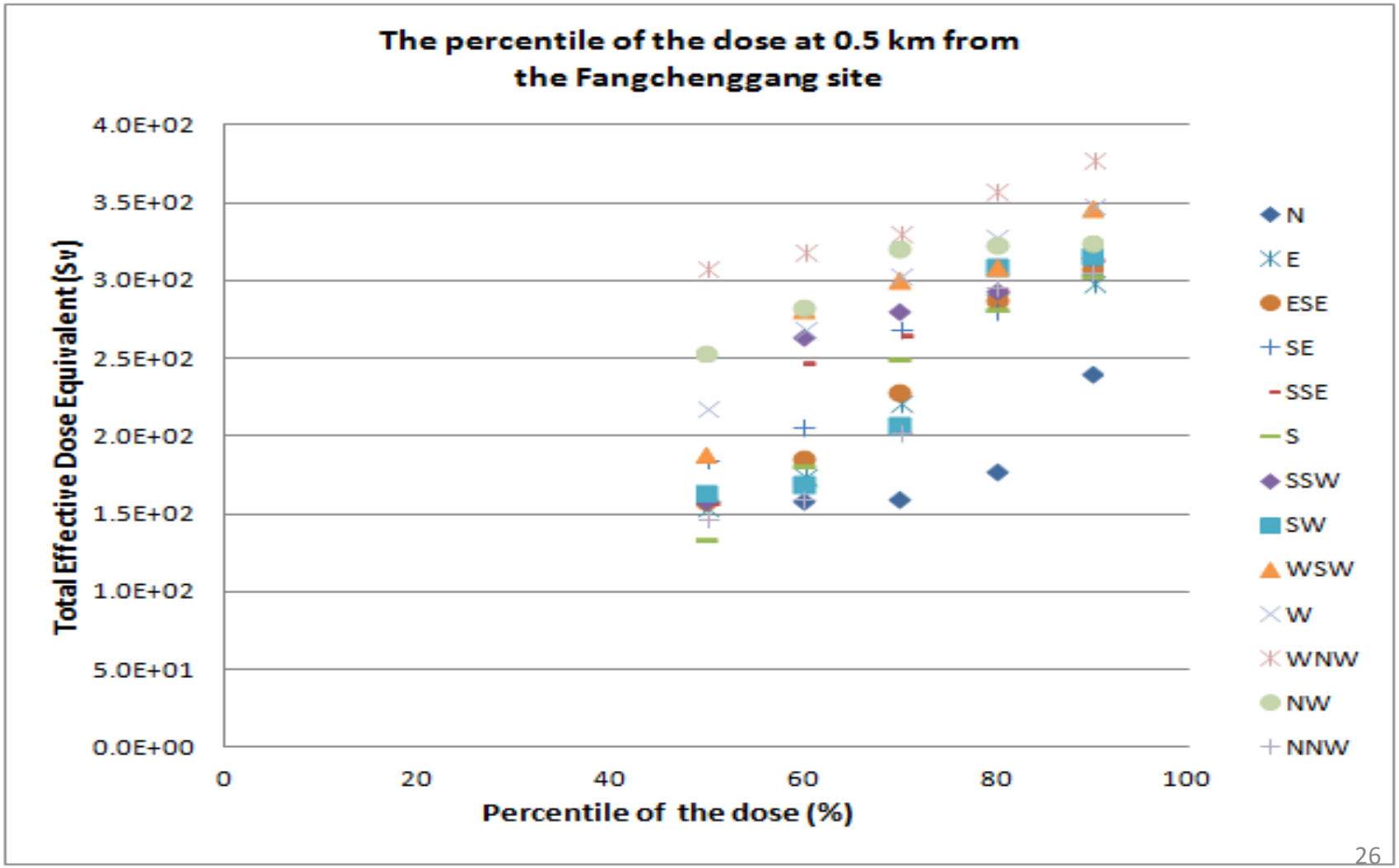
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



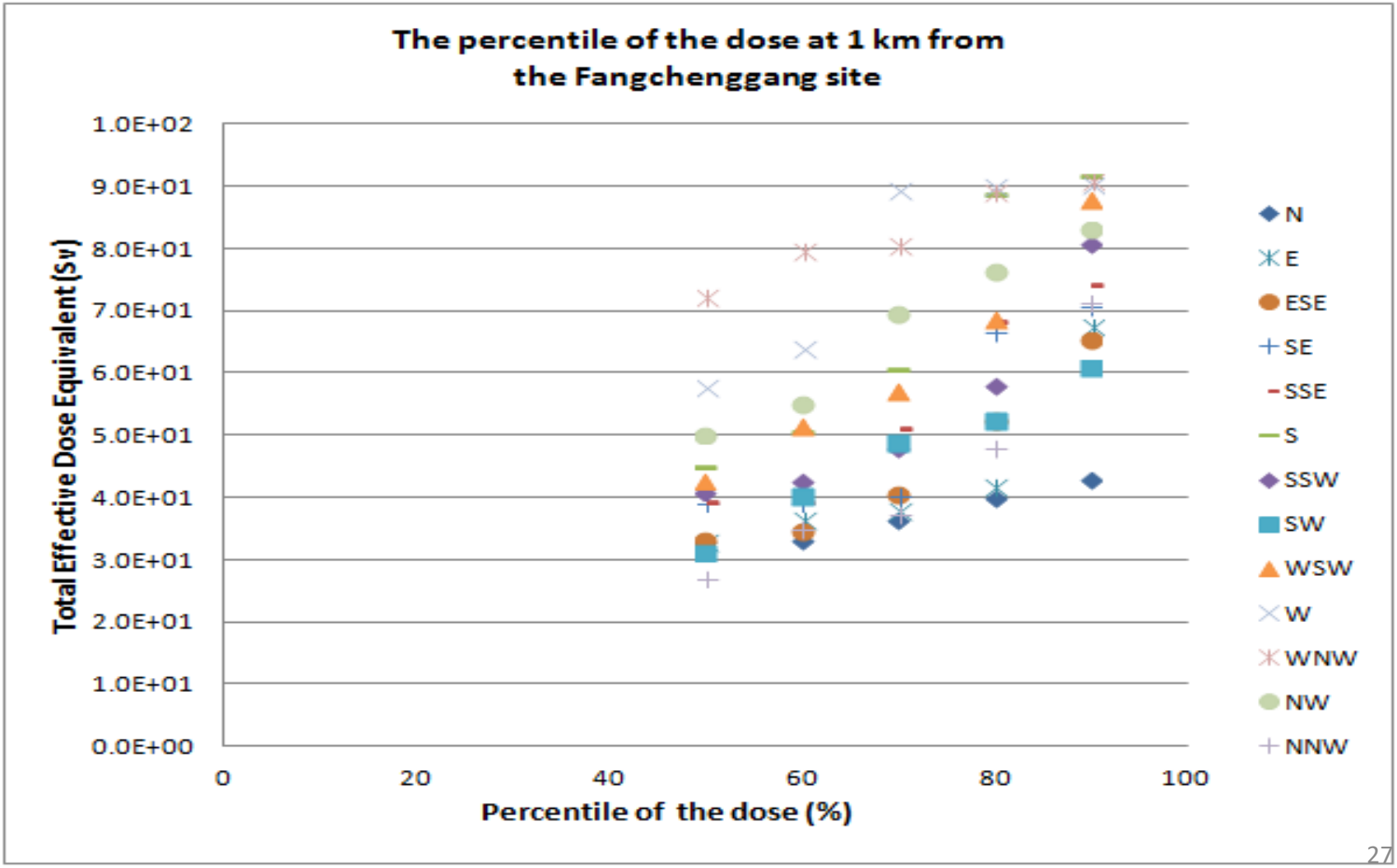
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



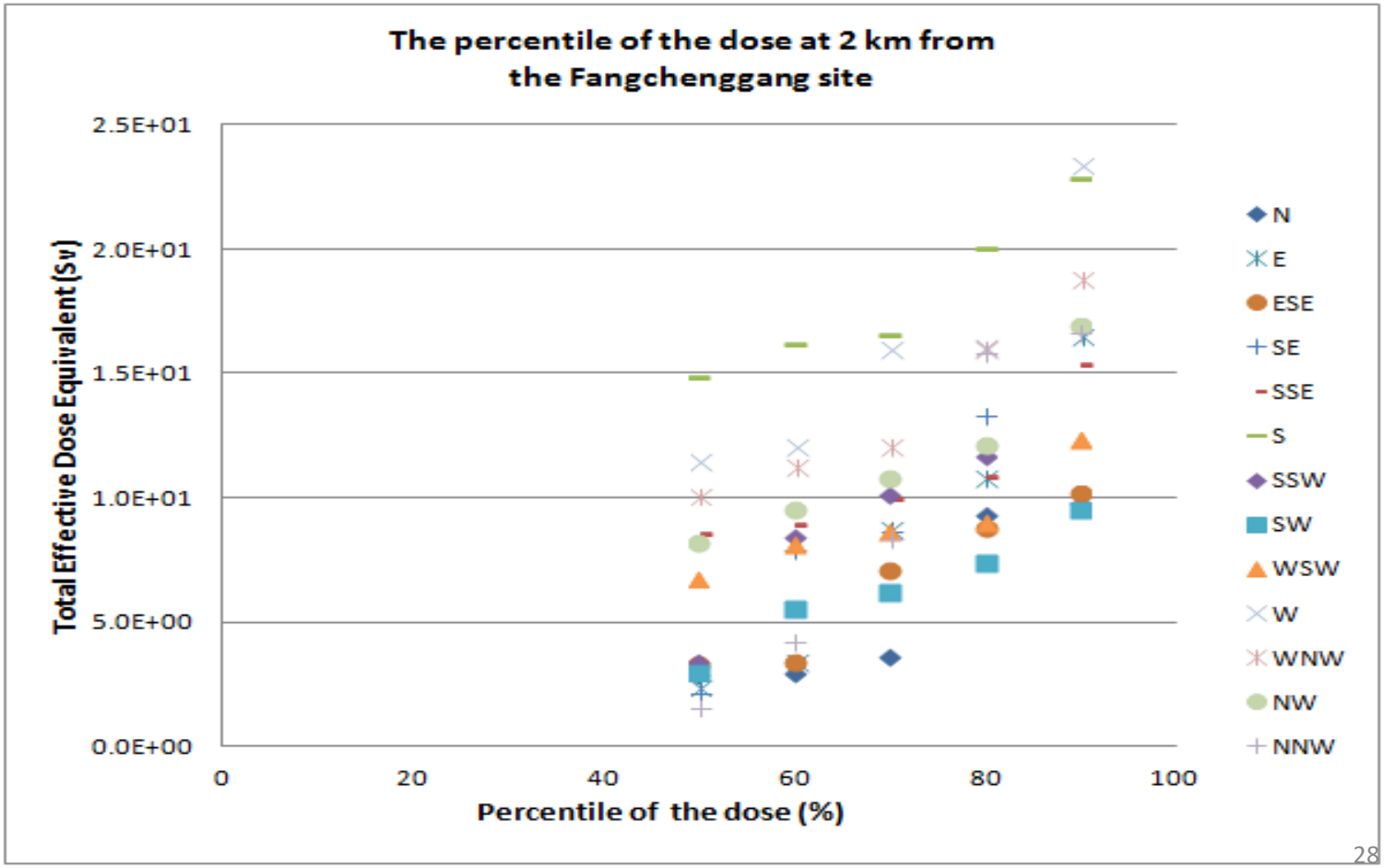
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



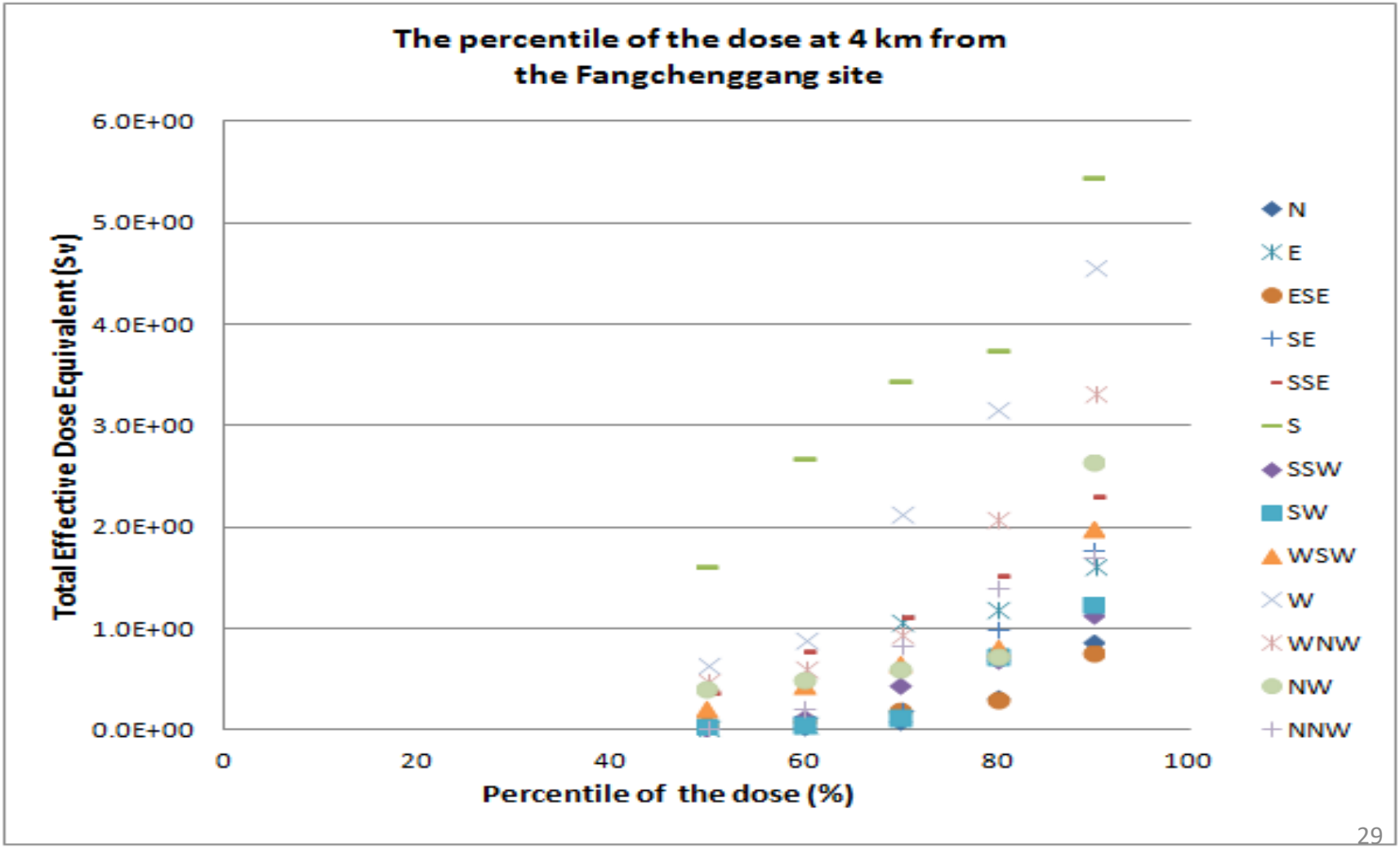
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



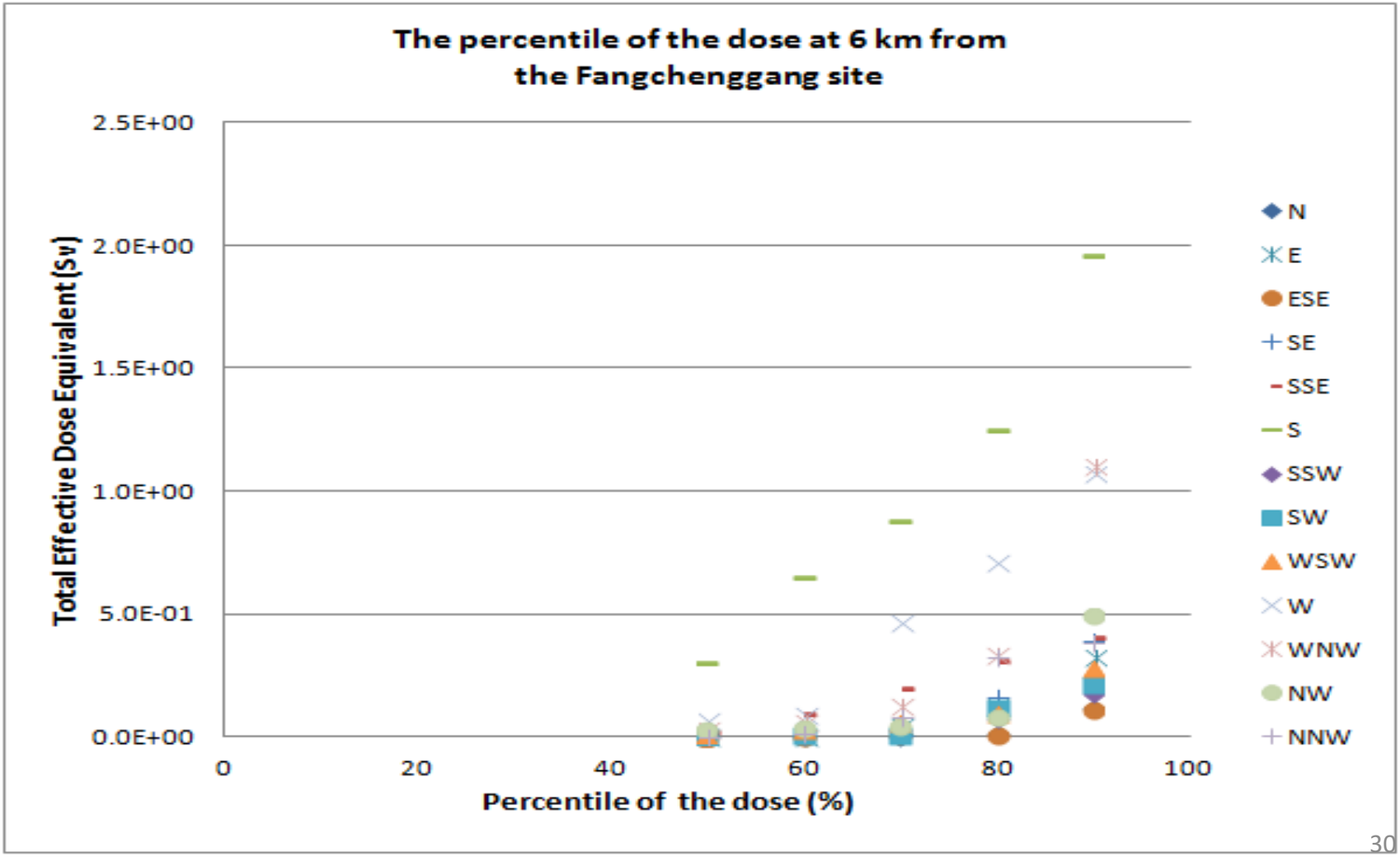
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



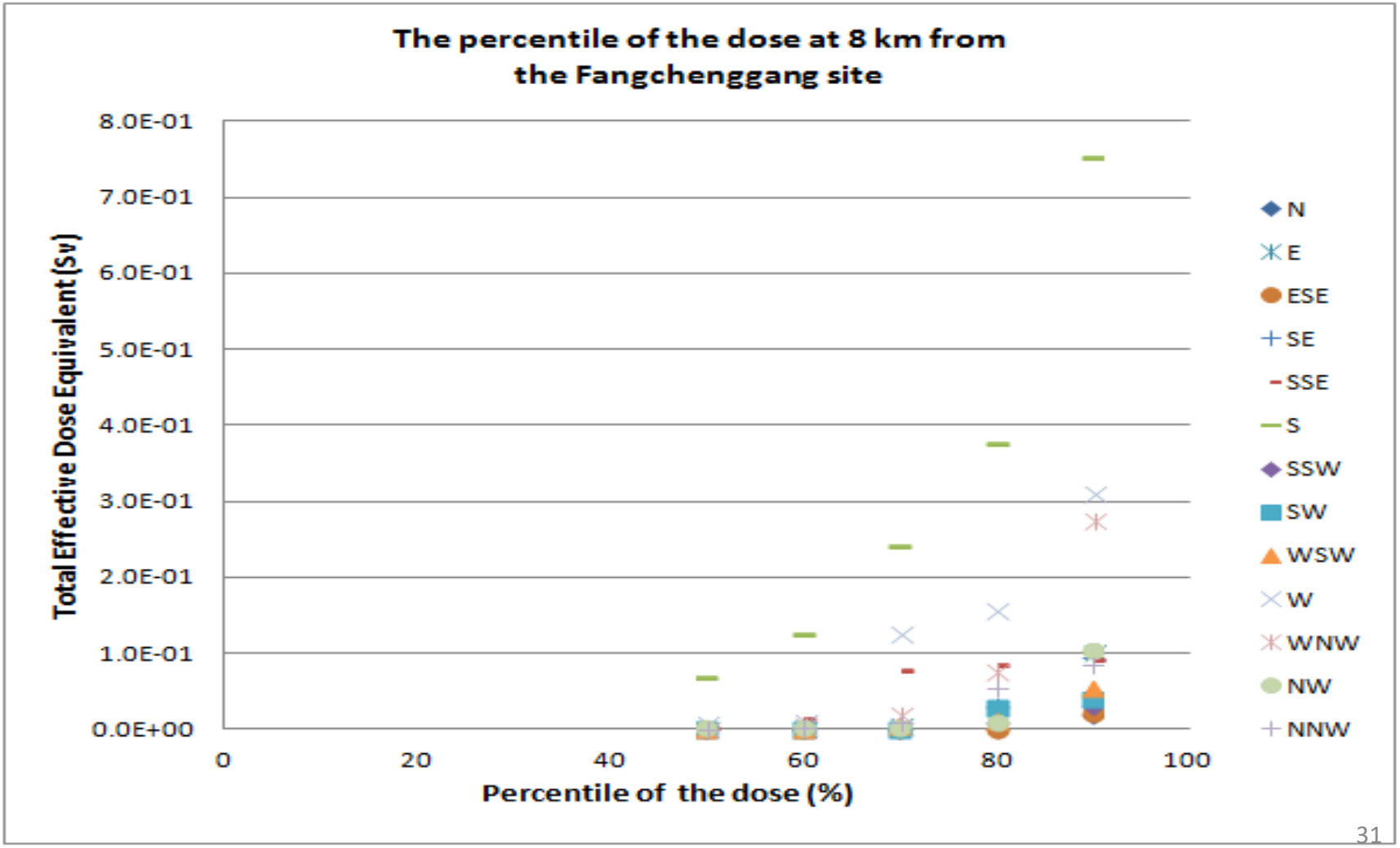
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



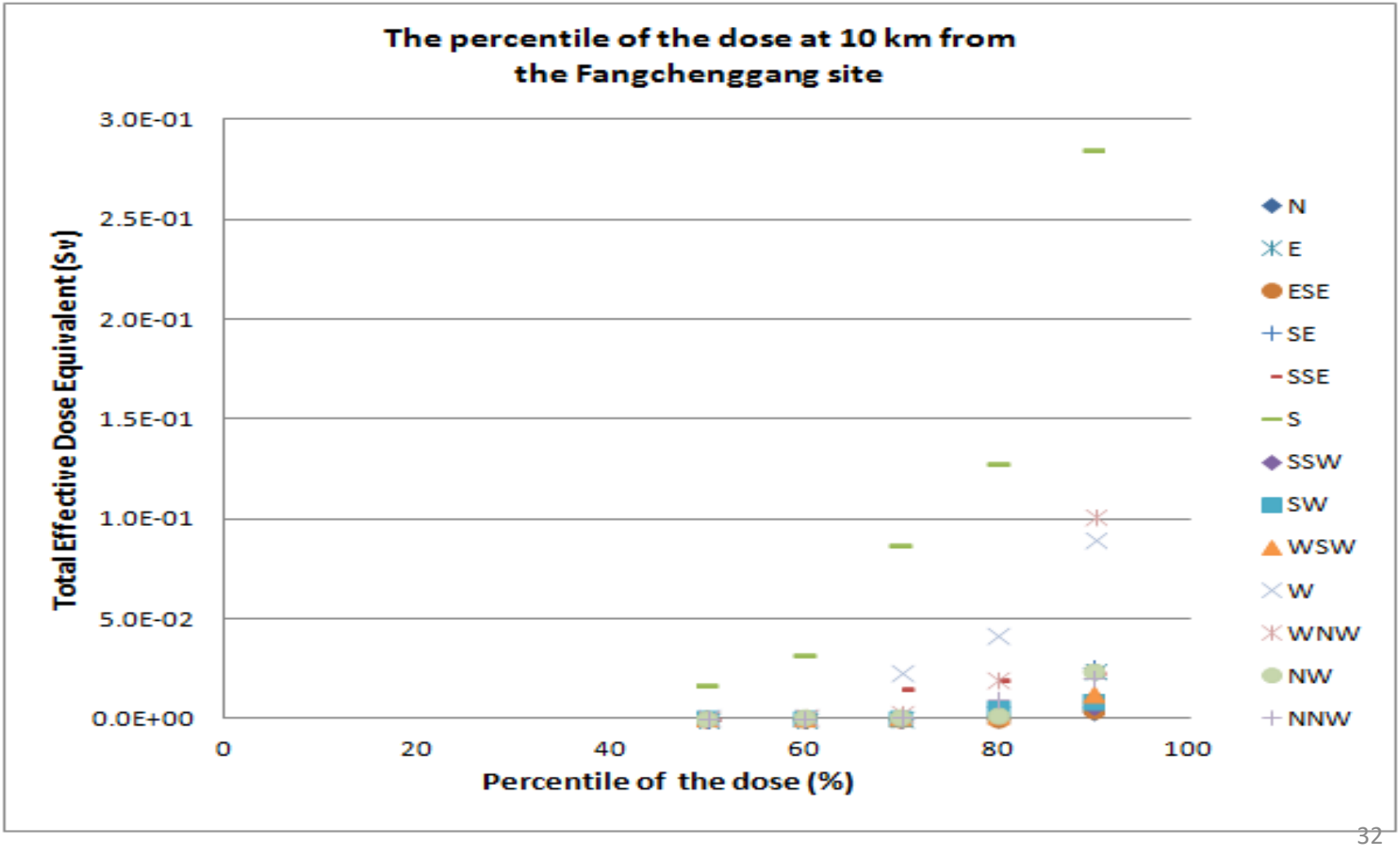
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



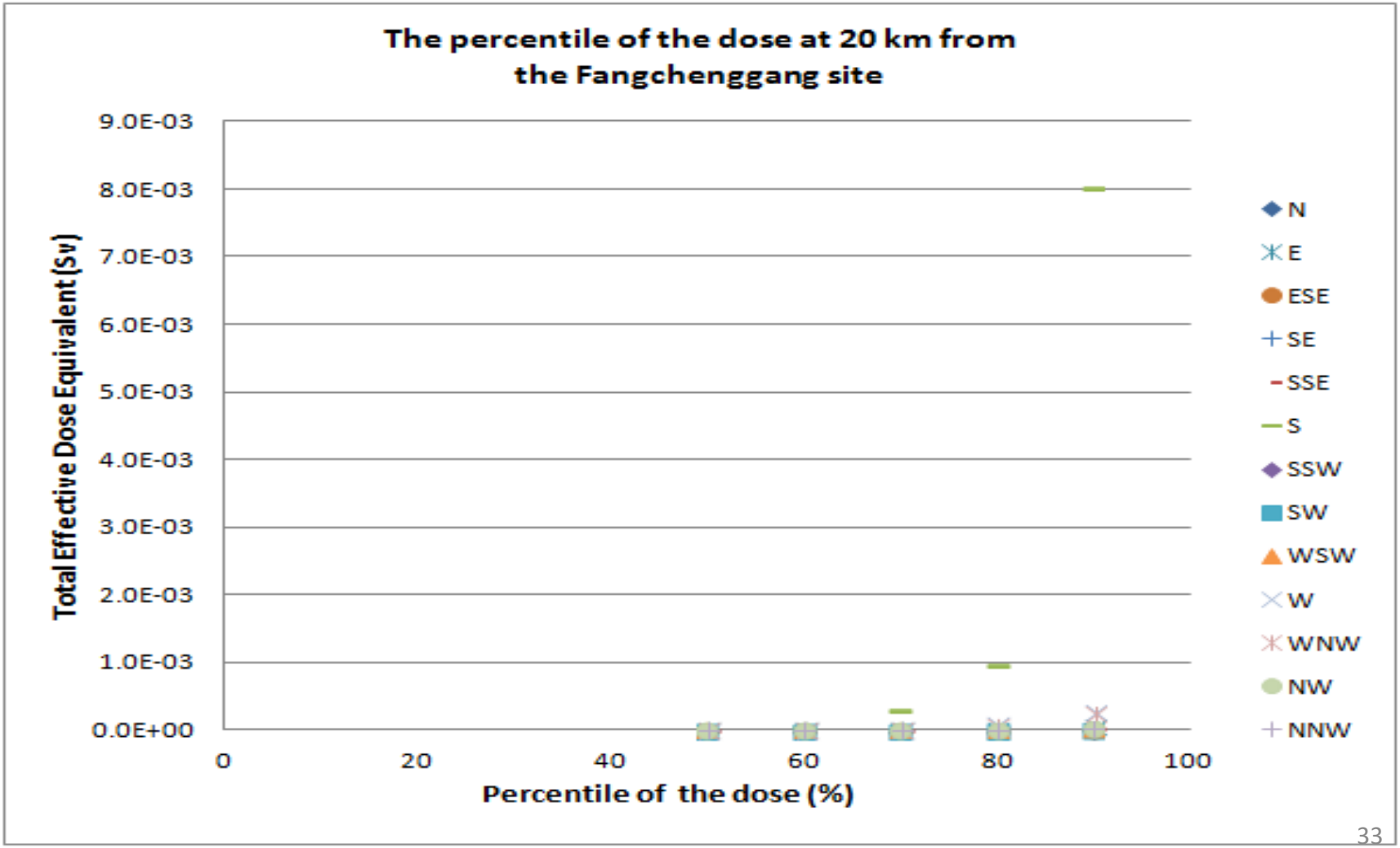
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



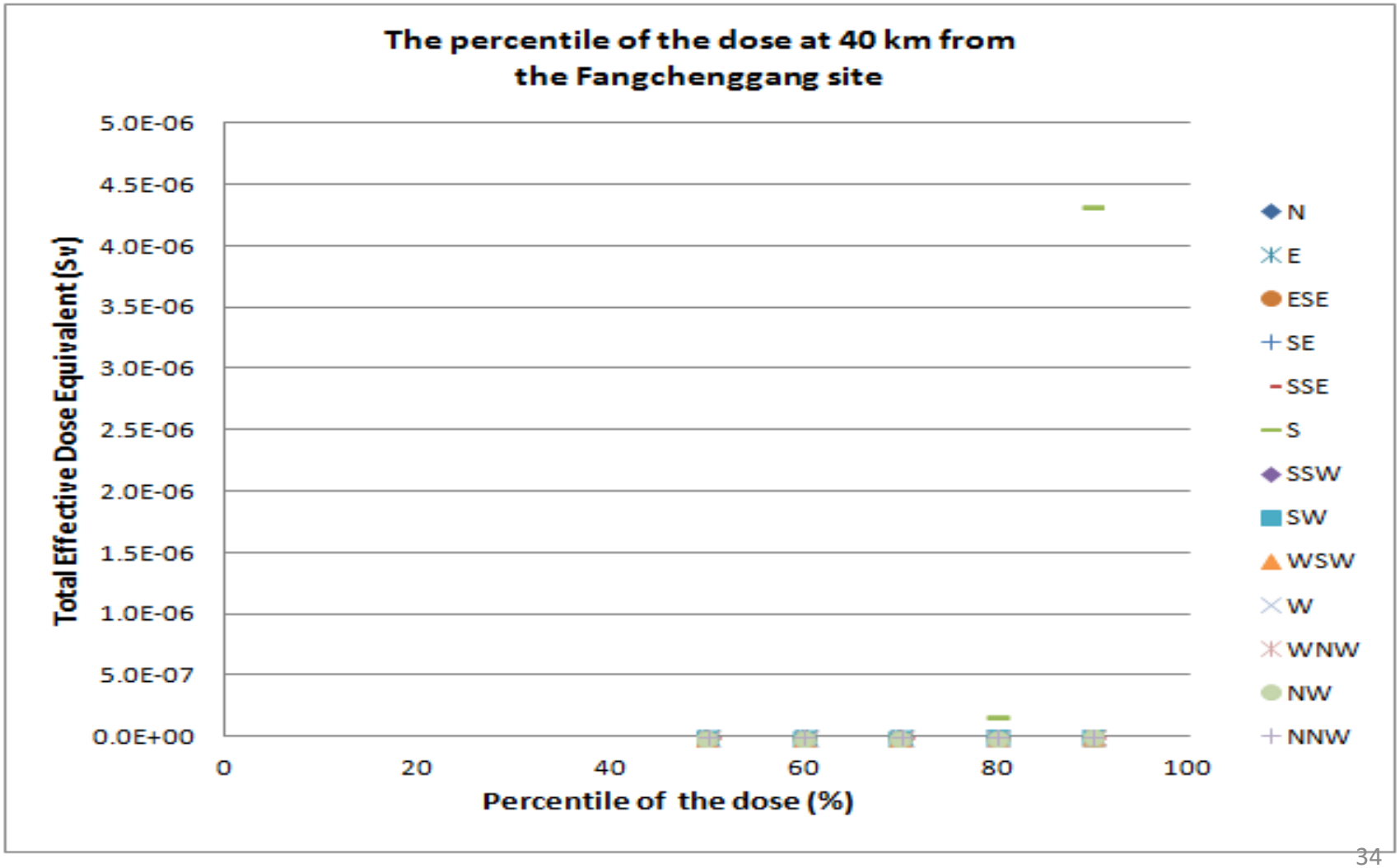
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



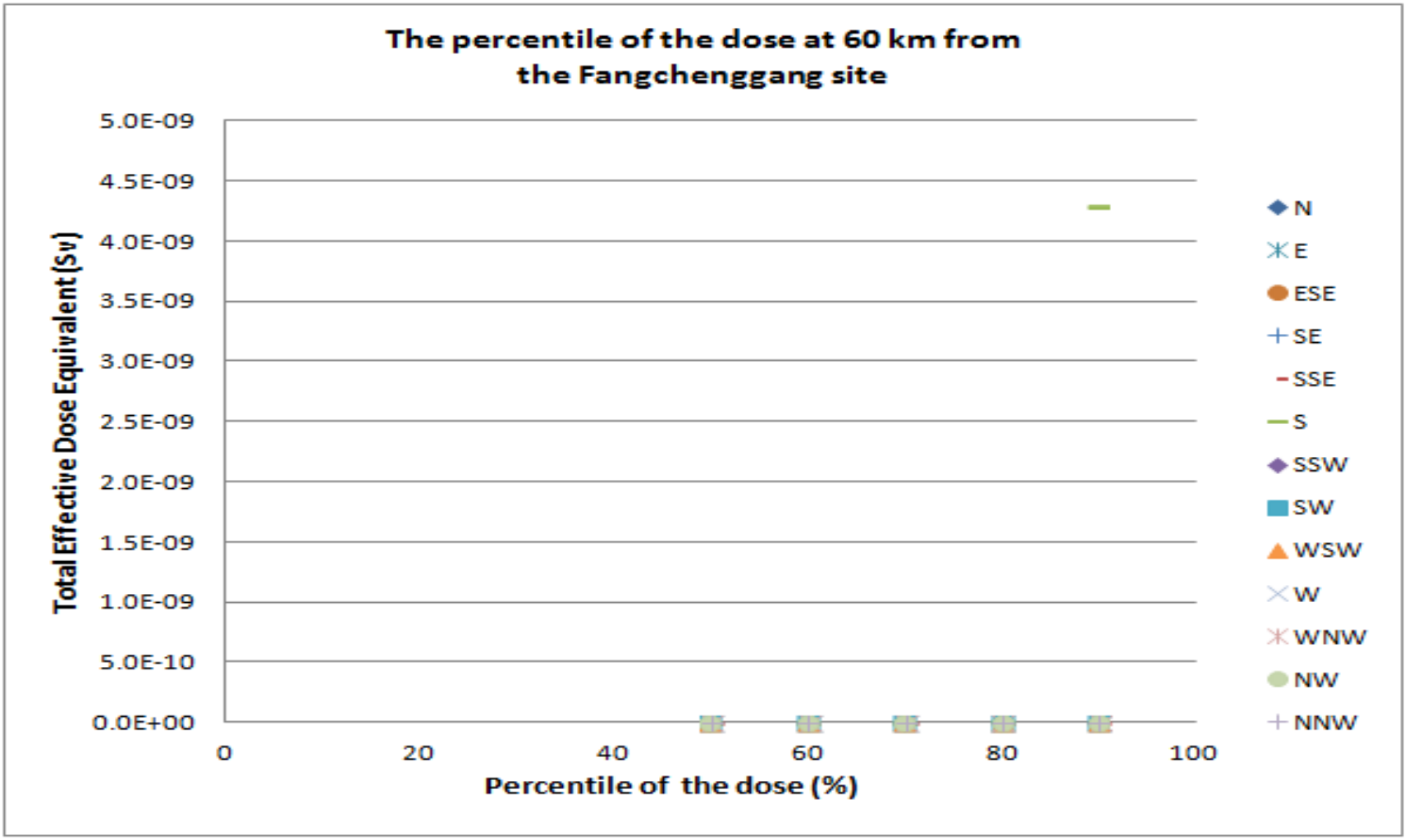
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



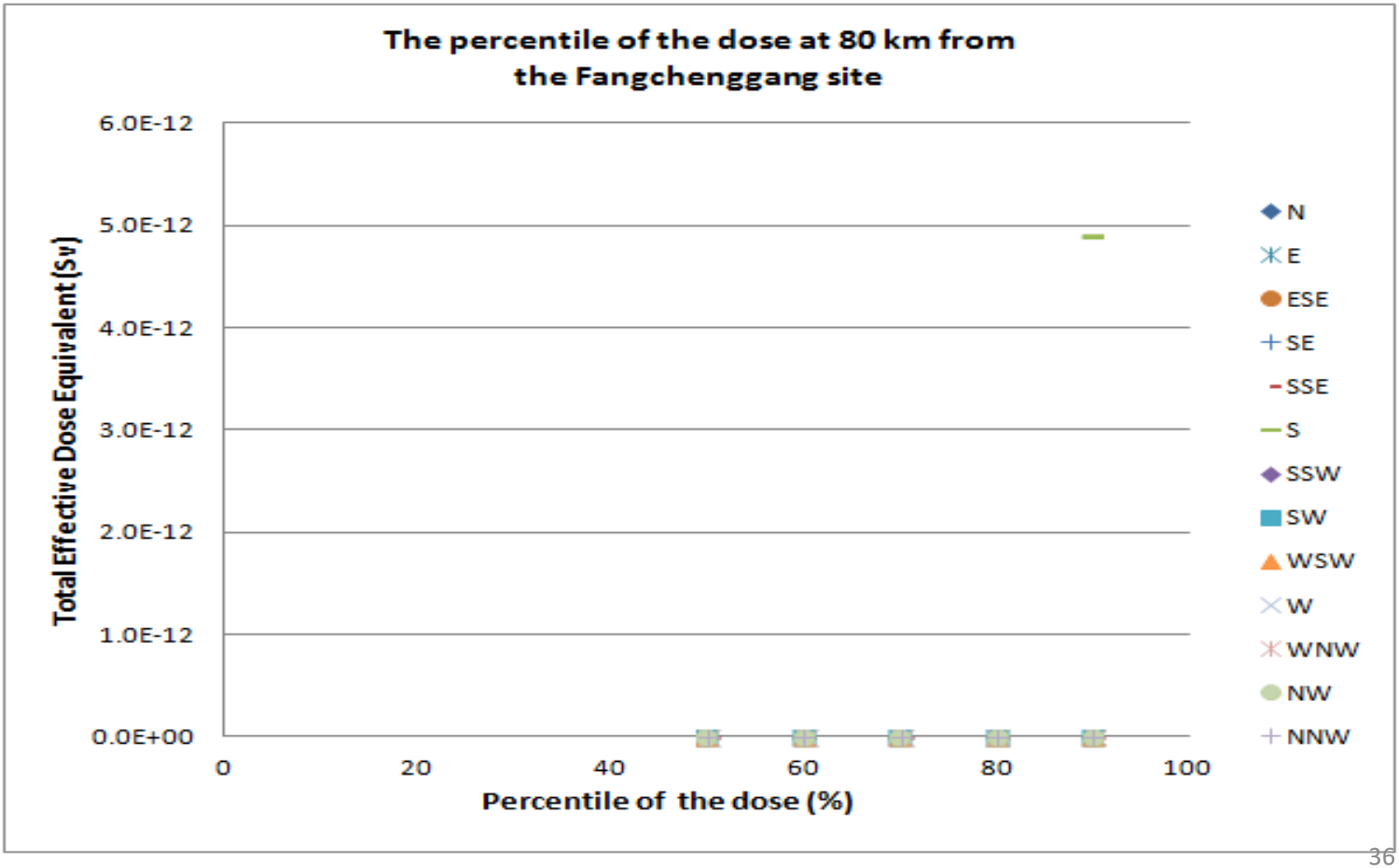
The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



The preliminary results of benchmark problem on the nuclear accident consequence assessment

Preliminary results



Thank you