Introduction
The fossil energy crisis and environment concerns have brought a dramatic development of renewable energy resources such as wind energy resources and solar energy resources over the past decade. The high uncertainty of renewable energy resources renders the existing probabilistic production simulation approach less applicable. Here we propose a new framework of probabilistic production simulation which gives better consideration of the variability/intermittency effects of renewable energy, especially the wind energy. This new framework uses Monte Carlo methods to realize the combination of probabilistic production simulation and stochastic process sampling.

Wind Resource Simulation Based on Stochastic Differential Equation Theory
Suppose the wind speed $\tilde{v}_i$ normalized by the monthly average wind speed and hourly average wind speed in a certain site is a stationary diffusion-type stochastic process which has a Weibull marginal distribution

$$f(\tilde{v}_i) = \frac{k}{c_i} \left(\frac{\tilde{v}_i}{c_i}\right)^{k-1} \exp\left[-\left(\frac{\tilde{v}_i}{c_i}\right)^k\right]$$  \hspace{1cm} (1)

and a decaying exponential autocorrelation function

$$\text{corr}(\tilde{v}_i, \tilde{v}_j) = e^{-\theta}, \ s, t \geq 0$$  \hspace{1cm} (2)

Then

$$d\tilde{V}_i = -\theta(\tilde{V}_i - \mu)dt + \sqrt{\sigma^2(V_i)}dW_i, t \geq 0$$  \hspace{1cm} (3)

So we could generate the normalized wind speed series by the following iterative equation:

$$\tilde{V}_{i+1} = \tilde{V}_i + d\tilde{V}_i$$  \hspace{1cm} (4)

Taking the wind speed seasonal rhythms and diurnal patterns into account, we adopt the wind speed seasonal factor and the wind speed diurnal factor to revise the normalized wind speed

$$V_{i+1} = hf_{m}\frac{hf_{m}}{dV_i}$$  \hspace{1cm} (5)

A typical wind turbine output characteristic function is employed to estimate the output power of the wind turbine at a certain wind speed.

Numerical Case Study Results

Distributed wind farms with little correlations beat large centralized wind farms in the contribution to the system reliability improvement, which is proved by Fig. 3 and Table I.

<table>
<thead>
<tr>
<th>Wind Farm Capacity</th>
<th>ALOLP</th>
<th>EENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 MW</td>
<td>1.711</td>
<td>1720.35</td>
</tr>
<tr>
<td>200 MW</td>
<td>1.683</td>
<td>1754.83</td>
</tr>
<tr>
<td>300 MW</td>
<td>1.666</td>
<td>1783.81</td>
</tr>
<tr>
<td>400 MW</td>
<td>1.649</td>
<td>1805.55</td>
</tr>
<tr>
<td>500 MW</td>
<td>1.634</td>
<td>1828.85</td>
</tr>
</tbody>
</table>

These figures show the actual yearly variations in reliability that the system could be expected to experience under different conditions of wind resources and the influence factors of wind energy production on system reliability improvement.