9 Prediction and assessment of impact on water environment

9.1 Prediction of impact of industrial wastewater on water quality

According to requirement of Clause 13, Item 2 of “Implementation of ‘Law of the People’s Republic of China on Environment Impact Assessment’ by Shanghai” on “the industrial enterprises with productive wastewater discharge rate of 1000t/d above shall be prohibited to dispose wastewater in township wastewater treatment plant but that shall dispose at the site, so as to control the discharge amount”. There are two methods for discharging the wastewater of Pusteel which has been treated and up to standard, one method is to discharge into inland water, another way is to discharge into Yangtze River through Shidongkou wastewater treatment plant. Based on the two programs, the prediction of impact on water quality will be carried out respectively as follows.

9.1.1 Prediction of impact on inland water quality

9.1.1.1 Hydrodynamic model for plain tidal river network

(1). Fundamental equation of hydrodynamic model

The governing equation of one-dimensional hydrodynamic model for river network is a Saint-Venant equation group:

\[
\begin{align}
\frac{\partial A}{\partial t} + \frac{\partial Q}{\partial x} &= q \\
\frac{\partial Q}{\partial t} + \frac{\partial}{\partial x} \left( \alpha \frac{Q^2}{A} \right) + gA \frac{\partial h}{\partial x} + g \frac{Q|q|}{C^2 AR} &= 0
\end{align}
\]

(1)

In the equation, the “x” and “t” refers to distance and time respectively; “A” refers to discharge section area; “Q” refers to flow rate; “h” refers to water level; “q” refers to lateral inflow; “C” refers to Chezy’s coefficient; “R” refers to hydraulic radius; “” refers to momentum correction coefficient; “g” refers to acceleration of gravity.

(2). Discretization of equation groups

The above-mentioned control equation groups will be discreted by Abbott six-point implicit format and, the water level and flow will be calculated in turn at each grid point through the discrete format instead of calculating synchronously,
and the points are referred to as “h” and “Q” point (see Fig 9.1-1).

This kind of format is stable unconditionally, and can be calculated stably under considerable Courant; you can select longer time step to save computing time.

Fig 9.1-1 The alternative layout of Abbott format water lever and flow point

Introducing storage width Bs and the continuity equation can be written as:

\[
B_s \frac{\partial h}{\partial t} + \frac{\partial Q}{\partial x} = q \quad (2)
\]

Adopting the discrete format as Fig 9.1-2, the continuity equation can be written as:

\[
B_s \frac{h_{j+1}^{n+1} - h_j^n}{\Delta t} + \left( \frac{Q_{j+1}^{n+1} + Q_j^n}{2} - \frac{Q_{j+1}^{n+1} + Q_{j-1}^{n+1}}{2} \right) \frac{\Delta x_j}{\Delta t} = q_j \quad (3)
\]

Fig 9.1-2 Abbott six-point central difference scheme
In similar manner, the difference type of the momentum equation at the flow point is:

\[
\frac{Q_{j+1}^n - Q_j^n}{\Delta t} + \frac{[\alpha Q_j^n/A]_{j+1/2}^{n+1/2} - [\alpha Q_{j+1}^n/A]_{j+1}^{n+1/2}}{\Delta 2x_j} + \left[ gA \right]_{j+1/2}^{n+1/2} \frac{(h_{j+1}^n + h_j^n)/2 - (h_{j+1}^n + h_{j+1}^n)/2}{\Delta 2x_j} + \frac{g}{C^2 AR} \frac{Q_{j+1}^n}{\Delta 2x_j} = 0
\]

(4)

In certain time step, in case the flow direction at grid point has changed, then the discrete format of \(Q_j^n\) can be written as:

\[
Q_j^n = \theta Q_j^{n+1} + Q_j^n - (\theta - 1)Q_j^n Q_j^n
\]

(5)

Of which: \(0.5 \leq \theta \leq 1\)

After adjusting, the formula (3) can be written as:

\[
\alpha_j h_{j+1}^{n+1} + \beta_j Q_{j+1}^{n+1} + \gamma_j Q_{j+1}^{n+1} = \delta_j
\]

(6)

After adjusting, the formula (4) can be written as:

\[
\alpha_j h_{j+1}^{n+1} + \beta_j Q_{j+1}^{n+1} + \gamma_j h_{j+1}^{n+1} = \delta_j
\]

(7)

(3). Solution of discrete equation groups

I Equation about riverway

As previously discussed, the relationship between hydraulic parameter \(Z\) (water level: \(h\) or flow rate: \(Q\)) at any point of river way and adjacent grid point can be expressed to be a linear equation:

\[
\alpha_j Z_{j+1}^{n+1} + \beta_j Z_{j+1}^{n+1} + \gamma_j Z_{j+1}^{n+1} = \delta_j
\]

(8)

The coefficient in the above formula can be calculated according to formula (6) and (7).

If there is “n” grid points in riverway, as the head and end grid point are always the water level points, the “n” is an odd number. Based on the all grid point of waterway, write the formula (8), then you can get “n” linear equations:
Of which, the \( H_{us} \) in the first equation and \( H_{ds} \) in the last equation refers to the water level at the branch point of upstream and downstream.

The water level at the first grid point of riverway is equivalent to that of upstream connected at the branch point: 
\[
\begin{align*}
\alpha_1 H_{us}^{n+1} + \beta_1 h_1^{n+1} + \gamma_1 Q_2^{n+1} &= \delta_1 \\
\alpha_2 h_1^{n+1} + \beta_2 Q_2^{n+1} + \gamma_2 h_3^{n+1} &= \delta_2 \\
& \vdots \\
\alpha_{n-1} h_{n-2}^{n+1} + \beta_{n-1} Q_{n-1}^{n+1} + \gamma_{n-1} h_n^{n+1} &= \delta_{n-1} \\
\alpha_n h_n^{n+1} + \beta_n Q_n^{n+1} + \gamma_n H_{ds}^{n+1} &= \delta_n
\end{align*}
\]

(9)

If the (boundary of upstream water level) and \( H_{ds} \) (boundary of downstream water level) are known for a single riverway, then the equation group (9) can be solved by elimination method.

With regard to river networks, by eliminating the functional elements of equation group (9), hydraulic parameters (water level or flow) for any points of riverway can be expressed to be functions of water level at the branch point of upstream and downstream:
\[
Z_j^{n+1} = c_j - a_j H_{us}^{n+1} - b_j H_{ds}^{n+1}
\]

(10)

Once the water level of each branch point is determined, the hydraulic parameters of any grid point can be solved by formula (10).
Fig 9.1-3 Equation schematic for branch point of river network

As shown in Fig 9.1-3, we can get the following formula by applying the continuity equation to the control body:

\[
\frac{H_{n+1}^n - H^n}{\Delta t} A_n = \frac{1}{2} (Q_{A,n+1}^n + Q_{B,n+1}^n - Q_{C,2}^n) + \frac{1}{2} (Q_{A,n+1}^n + Q_{B,n+1}^n - Q_{C,2}^n) \tag{11}
\]

Substitute the three items in second formula at the right of above-mentioned equation group with formula (10), and then we can get:

\[
\frac{H_{n+1}^n - H^n}{\Delta t} A_n = \frac{1}{2} (Q_{A,n+1}^n + Q_{B,n+1}^n - Q_{C,2}^n) + \frac{1}{2} (c_{A,n+1} - a_{A,n+1}H_{A,n+1}^n - b_{A,n+1}H_{B,n+1}^n) + c_{B,n+1} - a_{B,n+1}H_{B,n+1}^n - b_{B,n+1}H_{C,2}^n + c_{C,2} - a_{C,2}H_{C,n+1}^n + b_{C,2}H_{C,d}^n \tag{12}
\]

Of which, "H" refers to water level of the branch point; \( H_{A,us} \) and \( H_{B,us} \) refer to water level of branch point at downstream.

In formula (12), the water level of certain branch points is expressed by a liner function of water level of branch point of directly connected riverway. Also, we can get "N" similar equation groups (branch point equation group) related to all branch points (support the number is "N") of riverway. In case of the water level or flow is known, you can solve the branch point equation group by Gaussian elimination, and get the water level of branch point, which can be put into formula (10) to solve water level or flow of any grid point.

I Open boundary condition

If the time change for water level is supplied in the position of boundary nodes: \( h=h(t) \). Then the branch point equation at the boundary is (suppose the numbering of riverway where the riverway located is "j"):

\[
H_{j,n+1}^n = H_{us}^{n+1} \quad \text{or} \quad H_{j,n+1}^n = H_{ds}^{n+1} \tag{13}
\]

If the time change for flow is supplied in the position of boundary nodes: \( Q=Q(t) \).
Apply the continuity equation to the control body shown in Fig 9.1-4, and then you can get:

$$\frac{H^{n+1} - H^n}{\Delta t} - A_{bi} = \frac{1}{2}(Q_b^n - Q_{b1}^n) + \frac{1}{2}(Q_{b1}^{n+1} - Q_{b1}^{n+1})$$  \hspace{2cm} (14)$$

Put the $Q_{b1}^{n+1}$ in formula (14) through formula (8), and then you can get:

$$\frac{H^{n+1} - H^n}{\Delta t} - A_{bi} = \frac{1}{2}(Q_b^n - Q_{b1}^n) + \frac{1}{2}(Q_{b1}^{n+1} - c_2 + a_2 H^{n+1} + b_2 H_{w_{10}}^{n+1})$$  \hspace{2cm} (15)$$

If the relationship between flow and water level at the boundary point of riverway is $Q=Q(h)$, which can be treated as that of flow boundary, then you can get the equation similar as formula (15), but the $Q_b^n$ and $Q_{b1}^{n+1}$ shall be achieved through the relationship between flow and water level.

I Simulation of Weir and gate

There are many hydraulic structures such as weir and gate built in plain river network area, where the Saint-Venant equation cannot be applied; some special treatment shall be done according hydraulic characteristics of weir and gate. Most of gate dams in river network area of Shanghai belong to broad-crested weir-type, so the weir and gate are always treated in the way of flow point; the flow can be calculated by weir or orifice flow formula of broad crested weir sluice according to relationship of adjacent water level point, and then we can get the following equation similar to formula (7).

(4) Generalization of river network

Shanghai is located in the Yangtze delta; its upstream water is from Taihu and...
downstream is affected by the tide of Yangtze River mouth, and belongs to typical lake source-type plain tidal river network. In order to coordinate with the comprehensive administration planning for Tai Lake basin, the administration of water conservancy of Shanghai is divided into eleven pieces, such as Dingnan, Dingbei, Yunnan, Tainan and Taibei etc.. Now 170 or more regulating sluice, gate and hydro junction stations and 40 or more pump stations have been constructed and planned, which can form a separate water conservancy control piece to control flood-waterlogging disaster and create conditions for comprehensively treating and dispatching water sources.

The river network nearby Yangsheng River will be subdivided based on original generalization river network (see Fig 9.1-5) in this environmental impact assessment, and it covers all urban-level and district-level riverway as well as part of town-level riverway in north of Jiading and Baoshan; The number of river, gate and pump station after subdivision is 295, 157 and 48 respectively.

![Fig 9.1-5  The diagram of river network of Shanghai](image)

(5). Calibration of hydrodynamic model

Under the consideration of the calculation stability and time, the time step for calculation of the model can be set as 5 min.

Based on the water level and flow data measured from more than ten sections of Huangpu River, Suzhou River and its main branch from June to September, 1999 when the third comprehensive test of water diversion on Suzhou River was carried, the hydrodynamic model of river network established is to be calibrated. Roughness coefficient is determined to be basic calibration parameters in model calibration, and for main stream of Huangpu River is 0.02-0.028, for main stream
of Suzhou is 0.02-0.06 and for other riverway is between 0.02 and 0.04. The comparison between calculation result and measured value of water level and flow is shown in Fig 9.1-6, 9.1-7 and 9.1-8.

Fig 9.1-6 The comparison of between measured and calculated water level about main sections of Suzhou and Huangpu River
Fig 9.1-7 The comparison of between measured and calculated flow about main sections of Suzhou and Huangpu River.
It can be seen from the results of calibration in the model that, the calculated value of water level and flow for main rivers matches well with measured value, horizontal average error is less than 5% and error deviation for flow of main stream is less than 10%. Since the branch is mainly affected by control gates of each water conservancy zone, enough detailed operation data about gates are not available, thus the error from individual measuring station can be relatively great, but it shall be limited in 20%. The hydrodynamic simulation can supply relatively accurate flow conditions for model of water quality.

Fig 9.1-8 The comparison of flow and water level of measuring station in north of Jiabao and Yunnan
9.1.1.2 Water quality model for plain tidal river network

(1) Basic control equation

The control equation of water quality model for river network is 1-dimension convection-diffusion equation, and its basic presumption is: the matters are mixed completely on the section; matters are conservational or conform to reaction kinetics; conforming to Fick diffusion law, i.e. diffusion is proportional to the concentration gradient. The one-dimensional convection-diffusion equation is:

\[
\frac{\partial AC}{\partial t} + \frac{\partial QC}{\partial x} - \frac{\partial}{\partial x} (AD \frac{\partial C}{\partial x}) = -AKC + C_2q
\]

Of which:

"x" and "t" refers to space coordinates (m) and time coordinate (s) respectively; "C" refers to concentration of matters (mg/L);

"D" refers to longitudinal diffusivity (m²/s); "A" refers to area of cross section (m²);

"q" refers to lateral inflow (m³/s);

C2 refers to concentration of source/inflow (mg/L); K refers to linear attenuation coefficient (1/d).

(2) The discretization and derivation of convection diffusion equation

The discretization of convection diffusion equation

In order to reduce numerical discretization and ensure the conservation of mass, the time and space center implicit difference scheme can be used for discretization of convection diffusion equation, and then according to the control volume listed in Fig 9.1-9, to deduce the discretization format of convection diffusion equation.
Fig 9.1-9 Schematic diagram of the control volume for convection diffusion process

\[
\frac{V_{j}^{n+1/2}C_{j}^{n+1}}{\Delta t} - \frac{V_{j}^{n+1/2}C_{j}^{n}}{\Delta t} + T_{j+1/2}^{n+1/2} - T_{j-1/2}^{n+1/2} = q_{j}^{n+1/2}C_{2j}^{n+1/2} - V_{j}^{n+1/2}K_{j}C_{j}^{n}
\]

Of which: "\(j\)" refers to number of grid; "\(n\)" refers to time step; "\(\Delta t\)" refers to volume; "\(T\)" refers to the conveying capacity through control volume; "\(Cq\)" refers to concentration of lateral inflow matters.

The discretization format of convection diffusion equation is:

\[
T_{j+1/2}^{n+1/2} = Q_{j+1/2}^{n+1/2}C_{j+1/2}^{*} - A_{j+1/2}^{n+1/2}D \frac{C_{j+1}^{n+1/2} - C_{j}^{n+1/2}}{\Delta x}
\]

Of which: \(\Delta x\) refers to space step; \(Q_{j+1/2}^{n+1/2}\) refers to flow through right side wall of control volume; \(A_{j+1/2}^{n+1/2}\) refers to cross-sectional area of right side wall; \(C_{j+1/2}^{*}\) refers to interpolate concentration value of upstream, and can be calculated as the following:

\[
C_{j+1/2}^{*} = \frac{1}{4}(C_{j+1}^{n+1} + C_{j}^{n+1} + C_{j+1}^{n} + C_{j}^{n}) - \min\left(1 + \frac{\sigma^2}{2}, \frac{1}{4\sigma}\right)(C_{j+1}^{n} - 2C_{j}^{n} + C_{j-1}^{n})
\]

In the formula, the \(\sigma\) refers to Kelang, \(\sigma = u\Delta t/\Delta x\).

Collate the above-mentioned formulas and you can get any time step; the implicit difference equation related to the concentration of adjacent three grid points is:

\[
\alpha_{j}C_{j-1}^{n+1} + \beta_{j}C_{j}^{n+1} + \gamma_{j}C_{j+1}^{n+1} = \delta_{j}
\]

The condition for open boundary outflow:

\[
\frac{\partial^2 C}{\partial x^2} = 0
\]

If the outflow boundary turns into inflow boundary, please refer to the following formula:
\[ C = C_{\text{bf}} + (C_{\text{out}} - C_{\text{bf}})e^{-\tau_{\text{mix}}K_{\text{mix}}} \]

Of which: \( C_{\text{bf}} \) refers to incoming boundary concentration; \( C_{\text{out}} \) refers to the boundary concentration prior to changing of flow direction; \( K_{\text{mix}} \) refers to time scale determined during incoming; \( \tau_{\text{mix}} \) refers to the time calculated from the changing of flow direction.

The characteristics under closed boundary are that no flow and exchange of matters happening on the boundary: \( Q = 0 \) and \( \partial C / \partial x = 0 \).

The above-mentioned equation groups can be solved by "double-scan method", which is the same with hydrodynamic model.

(3) Process model for water quality change

The migration and transformation of organic pollutants in rivers, especially for water pollutants, is a complex physical, chemical and biological process; see Fig 9.1-10.

![Fig 9.1-10: The schematic drawing of water quality change](attachment://image.png)

The physical process: process of plug flow shift, turbulent diffusion and dispersion of pollutants along with river water; adsorbing, desorbing, depositing and resuspending with suspended mud and sand particles; heat transfer and evaporation of pollutants as well as transport of bed mud with pollutants as carrier. The biochemical process includes non-oxygen and oxygen stages, of
which, the oxygen process includes oxidative decomposition of carbon and nitrogen containing compound. Non-oxygen process includes denitrogenation reaction; the nitrate nitrogen in water will be reduced to nitrite nitrogen, and at last forms nitrogen.

(4) Coupling calculation of water quality change and convection diffusion process

The coupling calculation process about water quality change and convection diffusion is as follows:

① Calculate concentration \( C_{n+1,AD} \) of water quality constituents at \( n+1 \) time step through convection diffusion module;

② Calculate the concentration gradient \( LC_{n+1,AD} = (C_{n+1,AD} - C_{n,AD})/L_D \) caused by convection diffusion;

③ Calculate the concentration \( C_{n+1,WQ} \) of water quality constituents at “\( n+1 \)” time step through water quality module;

④ Calculate the concentration gradient \( LC_{n+1,WQ} = (C_{n+1,WQ} - C_{n,WQ})/L_I \) caused by water quality change;

⑤ Calculate the total concentration gradient \( LC_{n+1,WQ} = LC_{n+1,WQ} + LC_{n+1,AD} \);

⑥ Integrate the calculation result in step 5 through 5-order Runge-Kutta method, and then the concentration of matter in this time step can be got.

(5) Generalization of model river network

The generalized river network of water quality model shall be in accordance with hydrodynamic model.

(6) Calculation of pollution load

At present, there are many sources of pollutions discharged directly in Shanghai; with the help of GIS tools and by statistical analysis and based on the whereabouts of the sewage discharge, and the principle of discharge nearby, converting the point pollution sources of Shanghai into boundary documents of water quality model.

With the scope of research, LOAD module is to be used to estimate the non-point source pollution load which divided according to water conservancy zones, by carrying out statistical analysis about land use, amount of precipitation,
population density and other pollution data of each collecting basin, and then calculating the pollution load.

(7) Calibration and verification of the model

As lack of simultaneous monitoring data about water quality in north of Jiading and Baoshan District, the calibration of river network water quality model will be carried out according to the data about the water quality of Huangpu River, Suzhou River and their main branch measured from June to September, 1999 when the third comprehensive test of water diversion on Suzhou River was carried. The main parameters and result for model calibration is shown in Table 1. The comparison between calculation and measured result of main water quality indicators about typical section is shown from Fig 9.1-11 to 9.1-14.
Table 9.1-11 Comparison between model calibration and experimental results of main parameters of water quality

<table>
<thead>
<tr>
<th>Water quality parameters</th>
<th>Longitudinal dispersion coefficient (1/d)</th>
<th>COD degradation coefficient (1/d)</th>
<th>BOD degradation coefficient (1/d)</th>
<th>Reaeration coefficient (1/d)</th>
<th>Sediment oxygen (g O²/m²/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration results</td>
<td>5~15</td>
<td>0.05~0.2</td>
<td>0.1~0.3</td>
<td>0.1~0.4</td>
<td>1~6</td>
</tr>
<tr>
<td>Experimental results</td>
<td>5~35</td>
<td>0~0.25</td>
<td>0.05~0.8</td>
<td></td>
<td>0.75~5</td>
</tr>
</tbody>
</table>

Fig 9.1-11 The comparison between measured and calculated concentration of water quality of Huangdu
Fig 9.1-12  The comparison between measured and calculated concentration of water quality of Beixinjing
Fig 9.1-13  The comparison between measured and calculated concentration of water quality of Zhejiang Road Bridge
Fig 9.1-14 Comparison between measured and calculated DO value of mainstream and branch of Suzhou River

From the results that we know, the calculated values are basically the same with measured values with the average error within 20%. Since the branch is mainly affected by control gates of each water conservancy zone, while enough detailed and exact operation data about gates and data of pollution load are not available, which causes big error between calculated and measured concentration of water quality from individual measuring station; however the most of errors still are permissible and can conform to the requirements of engineering.

9.1.1.3 Water quality simulation program

(1) Selection of hydrographic conditions
It is about to select hydrodynamic conditions and rainfall data of dry season in typical dry year (1971) of Shanghai as hydrographic conditions in this model.

(2) The water diversion program about north of Jiading and Baoshan District

The water diversion program (introduced from north and supplied to the east) and water flow direction is shown in Fig 9.1-15.

![Fig 9.1-15 The water diversion program about north of Jiading and Baoshan District (introducing water from north and supplied to the east)](image)

(3) Water quality simulation program

The sewerage produced in this environmental impact assessment will be discharged from plant moat of Pusteel through Yangsheng River; Table 9.1-2 shows the water quality simulation program.

<table>
<thead>
<tr>
<th>No.</th>
<th>Water diversion mode</th>
<th>Hydrological computation conditions</th>
<th>Sewage treatment station of Pusteel</th>
<th>The discharge amount and standard planned by other local plants</th>
<th>Simulation water quality indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-water diversion</td>
<td>/ Dry season</td>
<td>Amount of sewage: 6240 m$^3$/d</td>
<td>Class III discharge standard</td>
<td>COD$_{cr}$, BOD$_5$ and petroleum oil</td>
</tr>
<tr>
<td></td>
<td>Introduced from the north and</td>
<td>Dry season</td>
<td>Amount of sewage: 8020 m$^3$/d</td>
<td>Class II discharge standard of Shanghai</td>
<td></td>
</tr>
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<td></td>
</tr>
</tbody>
</table>
9.1.1.4 Result analysis of water quality simulation

(1) Prediction and analysis of the influence on water quality of river network

In case of non-water diversion, the maximum incremental distribution of concentration of pollutants discharged into Suitang and Yangsheng River by Pusteel and planned project is shown in Fig 9.1-16 and 9.1-17.

Program for non-water diversion — diagram for COD$_{Cr}$ concentration increment

Water diversion program — diagram for COD$_{Cr}$ concentration increment

Fig 9.1-16  Distribution forecast of COD$_{Cr}$ concentration for river network
From the diagrams you can see that no matter whether or not the implementation of water diversion program, the riverway influenced by pollutions is limited to the river network to the east of Panjing and north of Yunzaobang, among which the pollution of riverway near the sewage outfalls at Yangsheng River, West Suitang River, Gujing and Wuyue Pool etc. are relatively obvious.

After the implementation of water diversion, the sewage will spread over the south of Yangsheng River along with water flow, and this will expand the range of polluted river network to some extent; however the increment of average concentration of pollutants in river network near the sewage outfalls dropped.
(2) Predication of the impact on water quality of Yangsheng River

The concentration increment of COD$_{Cr}$ and BOD$_5$ discharged into Yangsheng River (from West Suitang River to Yunzaobang) from tail water of sewage outfalls is shown in Fig 9.1-18 and Fig 9.1-19.

![Fig 9.1-18 The average concentration increment of COD$_{Cr}$ along Yangsheng River](image1)

![Fig 9.1-19 The average concentration increment of BOD$_5$ along Yangsheng River](image2)

The statistical data related to the length of river reach where the concentration increment has exceeded certain value is shown in Table 9.1-3, 9.1-4 and 9.1-5. It shall be noted that the statistical results in the table are only applicable to Yangsheng River and Xitang River, not to other small riverway connected to Yangsheng River such as Wuyue Pool and Gujing; therefore the actual length of river network influenced by pollutions shall be longer than that of listed in the table.

<table>
<thead>
<tr>
<th>Table 9.1-1 Length statistics (COD$_{Cr}$) of polluted river reach of Yangsheng River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit: km</td>
</tr>
</tbody>
</table>

9-23
### Table 9.1-1 Length statistics (BOD<sub>5</sub>) of polluted river reach of Yangsheng River

<table>
<thead>
<tr>
<th>Concentration increment</th>
<th>Non-water diversion</th>
<th>Water diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; &gt; 6.0 mg/L</td>
<td>1.0</td>
<td>/</td>
</tr>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; &gt; 4.0 mg/L</td>
<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; &gt; 3.0 mg/L</td>
<td>2.0</td>
<td>1.4</td>
</tr>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; &gt; 2.0 mg/L</td>
<td>2.4</td>
<td>2.6</td>
</tr>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; &gt; 1.0 mg/L</td>
<td>5.4</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Note: the “slash” in the table refers to the length of polluted river reach is less than the length of a grid (approx. 200m) in generalize river network of the model. The following is the same as.

From the table we can see:

If the implementation of water diversion has not been done under hydrological conditions in dry season, the water quality of water reach near Yangsheng River and West Sultang River will be influenced obviously by pollutions planned: the length of water reach in which the concentration increment of COD<sub>Cr</sub> exceeding 30 mg/L is approx. 1Km, and exceeding 20 mg/L is approx 1.8 Km; the length of water reach in which the concentration increment of BOD<sub>5</sub> exceeding 6.0 mg/L is 1.0 Km, and exceeding 4.0 mg/L is 1.7 Km. Even if the background concentration has not been considered, the concentration of COD<sub>Cr</sub> and BOD<sub>5</sub> in the approx 1km length water reach of Yangsheng River still exceeds the water quality standard of Class IV under the conditions of planning sewage.
As compared to the program of non-water diversion, the water diversion in dry season can reduce the concentration increment of pollutants in Yangsheng River and adjacent riverway under the conditions of planning sewage; so even if the program of water diversion is carried, the planning sewage will still bring out negative influence on the water quality of Yangsheng River and adjacent riverway.

9.1.1.5 Calculation and analysis on water environmental capacity of Yangsheng River

According to the designed hydrological condition, location of sewage outfalls, volume and quality of sewage, the constrain condition and objective condition for designed water quality, the maximum permissible pollution emissions in river reach for Pusteel’s planned project can be calculated.

(1) Calculation method about water environmental capacity

The computational model about water environmental capacity of river network pollutants can be established based on the basic equation of water volume and quality. The one-dimensional convection-diffusion equation for river is:

\[
\frac{\partial (AC)}{\partial t} + \frac{\partial (QC)}{\partial x} = \frac{\partial}{\partial x} \left( AD \frac{\partial C}{\partial x} \right) - KAC + qC_q
\]

Where: "C" refers to the concentration of pollutant; "K" refers to degradation coefficient of pollutant; "q" refers to lateral inflow; \( C_q \) refers to inflow concentration; "D" refers to longitudinal dispersion coefficient.

The computational formula for water environmental capacity can be got by simplifying and deducing the convection-diffusion equation:

\[
W_L = Q_0 (C_s - C_0) + qC_s + KVC_s
\]

\( W_L \) refers to permissible emissions; the pollutant degradation coefficient \( K \) can be from experimental analysis or from calibration result of water quality model.

The above-mentioned formula is applicable for computing steady capacity and dynamic capacity, and it is also applicable for computing the capacity of a one-way river and water environmental capacity of tidal river network.

When use the formula to compute water environmental capacity of tidal river, the inflow rate \( Q_0 \) shall be treated.
In the case of tidal river, the movement of $\Delta L$ river reach can be divided into the following four typical forms:

For the first flow form: $Q_0 = Q_1$, the second: $Q_0 = Q_2$, the third: $Q_0 = Q_1 + Q_2$
and the fourth: $Q_0 = 0$.

If a river is divided into "n" segments, and supposes that the permissible emissions in the "i" river reach is $\Delta W_i$, then the permissible emissions for the whole river are:

$$W = \sum_{i=1}^{n} \Delta W_i$$

For non-constant flow, not only shall the change of permissible discharge amount of pollutants along with place be considered, but also with time. Suppose the time "T" to be divided into "m" time interval, then the permissible discharge amount in time "T" can be set as:

$$T = m \Delta t$$

In the moment "j" and the "i" river reach, if the permissible discharge amount is $\Delta W_j$, then the permissible discharge amount for the river in time "T" is:
\[
W = \sum_{j=1}^{n} \sum_{i=1}^{m} \Delta W_j \Delta t_j
\]

(2) Selection of control index

According to wastewater pollution analysis and regional pollution of Pusteel, and the stipulations of “Overall Scheme for Controlling National Total Amount of Pollutants”, the COD$_{Cr}$, BOD$_5$ and petroleum oil are selected as total amount control indexes in this environmental impact assessment.

(3) Calculation program and selection of parameters

I Standards for water quality

According to layout of water function, the water quality of Yangsheng River shall meet Class IV water standard.

I When the water diversion is not carried, the boundary inflow water quality shall be in accordance with Class IV of water quality. Under the conditions of water diversion, it shall be in accordance with Class II-III of water quality.

I Designed hydrological condition

With the help of the hydrological conditions of typical dry year (1971) and by the calculation of capacity model based on simulation results from hydrodynamic model of river network, the hydrodynamic data such as flow rate, volume and flow velocity can be got.

(4) Calculation programs

From the calculation formula of environmental capacity we can see that the water environmental capacity of certain river reach depends on objective concentration of water quality, inflow rate and concentration of water quality, water volume of river reach and degradation coefficient of pollutants etc.

In this environmental impact assessment, the water environmental capacity of Yangsheng River is calculated and analyzed under the conditions of two programs which are non-water diversion program and the program of introducing water from north and supplied to the east.

(5) Analysis on results of capacity calculation

The calculation results for water environmental capacity of Yangsheng River (water reach from West Suitang River to Gujing River) are shown in Table 9.1-5.

Table 9.1-5 The water environmental capacity of Yangsheng River (water reach
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

from West Suitang River to Gujing River

<table>
<thead>
<tr>
<th>Water index</th>
<th>Planned emissions (t/d)</th>
<th>Permissible emissions (t/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-water diversion</td>
</tr>
<tr>
<td>COD&lt;sub&gt;Cr&lt;/sub&gt;</td>
<td>1.30</td>
<td>0.65</td>
</tr>
<tr>
<td>BOD&lt;sub&gt;5&lt;/sub&gt;</td>
<td>0.433</td>
<td>0.13</td>
</tr>
<tr>
<td>Petroleum oil</td>
<td>0.12</td>
<td>0.01</td>
</tr>
</tbody>
</table>

From the table we can see that under the hydrological conditions in dry season, the permissible emissions at the sewage outfall of Yangsheng River under implementation of water diversion are higher than that of non-water diversion.

Under the implementation of water diversion, the water environmental capacity of Yangsheng River reach near the designed sewage outfall (water reach from West Suitang River to Gujing River) is 1.25 t/d for COD<sub>Cr</sub>, 0.25 t/d for BOD<sub>5</sub> and 0.03 t/d for petroleum oil. The permissible emissions of COD<sub>Cr</sub>, BOD<sub>5</sub> and petroleum oil can not meet the designed requirements.

9.1.2 Prediction of impact on water quality of Yangtze River estuary

9.1.2.1 Plane 2-dimension hydrodynamic model of Yangtze River estuary

The ocean dynamic characteristics of waters are necessary for establishing hydrodynamic mode of estuary and bay. For sea area with shallow water and even mixing of sea water, two-dimension mathematical model with average water depth can be adopted.

The 2-dimension plain hydrodynamic model and convection-diffusion model (MIKE21) adopted in this study are used for analyzing the transport and diffusion of pollutants discharged into Yangtze River estuary. The hydrodynamic simulation is used for supplying the flow field needed for calculating water quality in water quality mode; the convection-diffusion model is used for quantitative analysis of the sewage impact, and used for assessing the location of sewage outfall and its treatment level according to the water quality of sensitive waters.

(1) Control equation of hydrodynamic model

Under the consideration of Bousinesque approximation and shallow assumptions as well as the impact of wind stress, the two-dimension hydrodynamic equation groups for vertical integration is:

Continuity equation:
\[
\frac{\partial \zeta}{\partial t} + \frac{\partial p}{\partial x} + \frac{\partial q}{\partial y} = S
\]

Momentum equation:

\[
\frac{\partial p}{\partial t} + \frac{\partial}{\partial x} \left( \frac{p^2}{h} \right) + \frac{\partial}{\partial y} \left( \frac{pq}{h} \right) + gh \frac{\partial \zeta}{\partial x} + \frac{gp \sqrt{p^2 + q^2}}{C^2 h^2} \\
- \frac{1}{\rho_w} \left[ \frac{\partial}{\partial x} \left( h \tau_{xx} \right) + \frac{\partial}{\partial y} \left( h \tau_{xy} \right) \right] - \Omega q - fVV_x + \frac{h}{\rho_w} \frac{\partial}{\partial x} (p_a) = 0
\]

\[
\frac{\partial q}{\partial t} + \frac{\partial}{\partial y} \left( \frac{q^2}{h} \right) + \frac{\partial}{\partial x} \left( \frac{pq}{h} \right) + gh \frac{\partial \zeta}{\partial y} + \frac{gp \sqrt{p^2 + q^2}}{C^2 h^2} \\
- \frac{1}{\rho_w} \left[ \frac{\partial}{\partial y} \left( h \tau_{yy} \right) + \frac{\partial}{\partial x} \left( h \tau_{yx} \right) \right] + \Omega p - fVV_y + \frac{h}{\rho_w} \frac{\partial}{\partial y} (p_a) = 0
\]

In the formula: "h" refers to water depth (m);

"p, q" refers to single-wide flow at x, y direction (m³/s/m);

\[ C = \frac{1}{n} H^{\frac{1}{6}} \] refers to Chezy’s coefficient, "n" refers to Manning coefficient;

"f" refers to wind resistance coefficient;

\[ V_x, V_y \] refers to wind speed (m/s);

\[ \Omega \] refers to Coriolis parameter;

\[ p_a \] refers to air pressure (Kg/m²);

\[ \rho_w \] refers to water density (Kg/m³);

\[ \tau_{xx}, \tau_{xy}, \tau_{yy} \] refers to shearing stress components;

For MIKE 21, the ADI method is used for solving the above-mentioned equation groups.

(2) Scope of model

In this environmental impact assessment, big and medium models are established, and their scopes are shown in Fig 9.1-21; the relationship between models and their
usage is shown in Table 9.1-6.

![Model diagram of Yangtze River estuary and Hangzhou Bay](image)

<table>
<thead>
<tr>
<th>Model</th>
<th>Scope</th>
<th>Grid size</th>
<th>Number of grid</th>
<th>Intended use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large model</td>
<td>Yangtze River estuary and Hangzhou Bay</td>
<td>500m*500m</td>
<td>510*596</td>
<td>1. Used for calibration and verification of parameters of hydrodynamic model and water quality model; 2. Used for supplying hydrodynamic force, water quality boundary and initial conditions.</td>
</tr>
<tr>
<td>Medium model</td>
<td>Yangtze estuary downstream of Chongtou and upstream of Nanbeigang, Changxing island</td>
<td>150m*150m</td>
<td>421*151</td>
<td>3. Used for simulating the water quality of tail water discharged into the Yangtze River estuary by Pusteel 4. Used for statistical analysis of the area and length of pollution belt near the sewage outfall.</td>
</tr>
</tbody>
</table>
(3) Boundary conditions of model

Waters open boundary: select the given tide level, and estimate by amplitude and phase from eleven tidal components.

Boundary of river: the rivers in the scope of the study include Yangtze River, Qiantang River, Huangpu River, Cao'ejiang and Yongjiang etc., among which the observed data is selected for Yangtze River, for other rivers, the average flow rate for years in dry and flood season is selected.

(4) Calibration and verification of the model

The calibration and verification of hydrodynamic model is based on the measured data such as tide level, flow rate, flow speed and direction etc. from typical measuring points of Yangtze River and Hangzhou Bay when measured from March to September, 2002.

The hydrodynamic test results are shown from Fig 9.1-22 to Fig 9.1-25.

![Fig 9.1-22 The verification results for water level of Luchao harbor and Zhongjun](image-url)
### Fig 9.1-23 The verification results for flow rate of Nangang and Beigang

<table>
<thead>
<tr>
<th>Time</th>
<th>Nangang</th>
<th>Beigang</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1 6:00</td>
<td>Actual measured data</td>
<td>Calculated data</td>
</tr>
<tr>
<td>3-2 6:00</td>
<td>Actual measured data</td>
<td>Calculated data</td>
</tr>
<tr>
<td>3-3 6:00</td>
<td>Actual measured data</td>
<td>Calculated data</td>
</tr>
<tr>
<td>3-4 6:00</td>
<td>Actual measured data</td>
<td>Calculated data</td>
</tr>
<tr>
<td>3-5 6:00</td>
<td>Actual measured data</td>
<td>Calculated data</td>
</tr>
</tbody>
</table>

### Fig 9.1-24 The verification results for flow direction of Qiyakou

<table>
<thead>
<tr>
<th>Time</th>
<th>Flow direction (degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5 9:36</td>
<td>Actual measured</td>
</tr>
<tr>
<td>3-5 20:24</td>
<td>Actual measured</td>
</tr>
<tr>
<td>3-6 7:12</td>
<td>Actual measured</td>
</tr>
<tr>
<td>3-6 18:00</td>
<td>Actual measured</td>
</tr>
</tbody>
</table>
Fig 9.1-25 The verification results for flow rate and flow direction of Beigang

The calculated value is basically same with measured value, and it can reflect the flow-field characteristics of Yangtze River estuary waters, so the value can provide exact hydrodynamic conditions for Lagrange drift and simulation of water quality.

9.1.2.2 Plane 2-Dimension water quality model of Yangtze River estuary and Hangzhou Bay

The basic equation for 2-dimension convection-diffusion model is:

\[
\frac{\partial C}{\partial t} + u \frac{\partial C}{\partial x} + v \frac{\partial C}{\partial y} = K_x \frac{\partial^2 C}{\partial x^2} + K_y \frac{\partial^2 C}{\partial y^2}
\]

Of which: "C" refers to substance concentration (mg/L); "u, v" refers to the flow rate component at the direction of x, y (m/s); "K_x, K_y" refers to turbulent dispersion coefficient at the direction of x, y (m^2/s).

The 2D UPWIND is used for discretizing the above-mentioned equation and solving the convection-diffusion equation.

The hydrodynamic model is used for calculating flow field, and the convection...
diffusion model is used for analyzing the permissible emissions and forecasting the incremental concentration of pollutants in various conditions and distribution characteristics.

9.1.2.3 Water quality simulation program

In this environmental impact assessment, the typical hydrological conditions in dry season (from January to March, 2004) is utilized as hydrological conditions for simulation of water quality, and the most unfavorable period is at the time of neap tide in dry season.

Waters open boundary: select the given tide level, and estimate by amplitude and phase from eleven tidal components

Upstream boundary of Yangtze River: adopting the measured flow rate of Jangyin station from January to March, 2004; for other rivers such as Qiangtang River, Huangpu River, Cao’e River and Yongjiang, the average flow rate for years in dry season is adopted.

Water quality boundary: in this environmental impact assessment, only the simulation of incremental concentration of discharged tail water by Pusteel is carried, so the concentration of water quality in upstream boundary of Yangtze River, boundary of open sea and inflow of other rivers is selected as zero. Index of water quality: COD\textsubscript{cr} and BOD\textsubscript{5}.

9.1.2.4 Analysis on results of water quality simulation

The tail water of Pusteel is discharged into Yangtze River estuary through discharge pipe of Shidongkou, and the distribution diagrams for concentration increment of pollutants in waters near outfall are shown in Fig 9.1-26 and 9.1-27.

From the simulation results, we can see that under unfavorable hydrological conditions, no obvious pollution belt will be formed in waters near sewage outfall, and the pollutions only have a little impact on the water quality of sensitive waters such as “Chongming water source protection zone”, “Qingcaosha water source protection zone” and “Chenhang water source protection zone”, e.g. the average concentration increment of COD\textsubscript{cr} in “Chenhang water source protection zone” is less than 0.01 mg/L, which is negligible compared to the background concentration of water quality in this waters and is far from sufficient to change the classification of water quality.
9.1.2.5 Analysis on compatibility, feasibility and rationality of combined discharge of industrial wastewater and wastewater from Shidongkou wastewater treatment plant

(1) Wastewater treatment scope for Shidongkou wastewater treatment plant

According to "Planning for Wastewater Specialty in Shanghai", the designed wastewater treatment system of Shidongkou is responsible for collecting and transporting of the sanitary sewage and industrial wastewater from Baoshan urban area north to Yunzaobang and the area south to Yunzaobang, west to Gonghexin Road, north to Lingshi Road and Wenshui Road, east to outer ring as well as Nanxiang, Jiangqiao and Fenbang area in Jiading District, these sewage will be discharged into Yangtze River after secondary treatment by Shidongkou wastewater treatment plant; the designed sewage treatment volume is 810,000 m$^3$/d.
The original treatment capacity for Shidongkou wastewater treatment plant is 800,000m$^3$/d, and meanwhile the “Construction Project Environmental Impact Report” is available. Under the consideration that the treatment capacity of 800,000m$^3$/d can bring certain influence to the Chenghang reservoir upstream and Qingcaosha water source downstream, so the treatment capacity of Shidongkou wastewater treatment plant is defined to 400,000m$^3$/d, and it is responsible for the area north to Yunzaobang and partial area south to Yunzaobang; Considering the relevance between the plant and the first-phase combined wastewater system, the other wastewater of approx.400,000m$^3$/d produced from south of Yunzaobang will be accessed into first-phase combined wastewater system and then conveyed to Zhuyuan, Pudong, where a large-scale wastewater treatment plant with treatment capacity of 1,200,000m$^3$/d is being built.

(2) Compatibility, feasibility and rationality analysis on combined discharge.

The Shidongkou wastewater treatment plant is located on the Yangtze riverbank of Shidongkou, Yuepu Town, Baoshan District, with the designed treatment capacity is 400,000m$^3$/d while the actual is 320,000m$^3$/d at present. The
wastewater treatment process for the plant is AAO process. The tail water from the plant is discharged by No.5 pump station, 400m offshore and 5m under water surface of Yangtze River.

The industrial wastewater discharged for this project is 6,240m³/d; if discharging these wastewater into inland water, this will increase the pollution degree of inland water; in case of discharging into wastewater treatment plant, this will be subject to the stipulations of Clause 13, Item 2 of “Implementation of ‘Law of the People’s Republic of China on Environment Impact Assessment’ by Shanghai” about “the industrial enterprises with productive wastewater discharge rate of 1000t/d above shall be prohibited to dispose wastewater in township wastewater treatment plant but that shall dispose at the site, so as to control the discharge amount”; in case of discharging into Yangtze River by self-setting sewage outfall, this will not be approved by Shanghai Water Sector. For the above reasons, the program that takes advantage of the tail pipe of Shidongkou wastewater treatment plant for discharge of industrial wastewater from Pusteel, which not only can the discharge of industrial wastewater be guaranteed, but also can meet the stipulation of “Implementation of ‘Law of the People’s Republic of China on Environment Impact Assessment’ by Shanghai” and the requirements of Shanghai Water Sector; furthermore, there is no technical problem between implementation of the program and the discharge of Shidongkou wastewater treatment plant. From the above we can see that the implementation of combined discharge of the wastewater from this project and Shidongkou wastewater treatment plant is feasible and reasonable.

9.1.3 Summary

(1) Under the hydrological conditions in dry season, the tail water of Pusteel discharged into Yangsheng River will bring a greater impact on water quality of Yangsheng River, West Suitang River and nearby riverway; after the implementation of water diversion, although the water quality of river network nearby the sewage outfall has been improved to some extent, the effect is not obvious and the impact on water quality is still evident. If the implementation of water diversion has not been done, the water quality of water reach near Yangsheng River and West Suitang River will be influenced obviously by pollutions planned: the length of water reach in which the concentration increment of COD₉₉ exceeding 30 mg/L is approx. 1Km, and exceeding 20 mg/L is approx 1.8 Km; the length of water reach in which the concentration increment of BOD₅ exceeding 6.0 mg/L is 1.0 Km, and exceeding 4.0 mg/L is 1.7 Km. Even if the background concentration has not been considered, the concentration of COD₉₉ and BOD₅ in the approx 1km length water reach of Yangsheng River still exceeds the water quality standard of Class IV under the conditions of planning sewage.
(2) Comparing to the situation without the water diversion program, the program in
dry season can help decrease to some extent the concentration of pollutants in
Yangsheng River waters and nearby waters under the planned discharge
condition. So the designed waste discharge will still present significantly a
diverse effect on the water quality in Yangsheng River and nearby waters even
the water diversion program is implemented.

(3) The water diversion program is able to increase the water environment capacity
of Yangsheng River to some extent, but the amount of discharged BOD$_5$ and
petroleum oil is still larger than that in the planned river reach (the river reach of
Yangsheng River from West Suitang River to Gujing).

(4) In dry season or under unfavorable hydrological conditions, the tail water
discharged by Pusteel will not form a polluted zone significantly in the waters
nearby the sewage outfall and it may present little effect on the water quality of
the sensitive waters in "Chenhang water resource protection area". And the
concentration can be ignored compared to the background water concentration
in the area and far from sufficient to change the type of water quality in the area.

It is recommended in this appraisal that the tail water discharge at the Yangtze
estuary is available.

9.2 Assessment for impact of warm water discharge on Yangtze
River

In this environmental impact assessment, the far-field simulation (MIKE21) and
near-field simulation (Plume) is conducted on the situation of warm water
discharged by Pusteel. The far-field simulation is used for forecasting the
influence range of warm water discharge and impact on nearby sensitive waters
under designed hydrological conditions, and the far-field numerical simulation
includes the process of: heat convection, heat diffusion, heat radiation and the
heat exchange between water body and air; the near-field simulation is used for
forecasting the situation of dilution and diffusion of warm water belt and change
of vertical water temperature at typical tidal current moment, and the
hydrodynamic design parameters (flow velocity ad water depth etc.) needed for
near-field simulation can be got from the results of far-field simulation.

9.2.1 Far-field simulation of warm water discharge

9.2.1.1 Control equation

The basic equation for water temperature field is 2-dimension convection-diffusion model:
\[
\frac{\partial T}{\partial t} + u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} = K_x \frac{\partial^2 T}{\partial x^2} + K_y \frac{\partial^2 T}{\partial y^2} + \frac{Q}{H \rho_w C_w}
\]

Where,

\( T \) refers to temperature of water body (°C);

\( H \) refers to water depth (m);

\( C_w \) refers to thermal capacitance of sea water (\( J/Kg^\circ C \));

\( Q \) refers to input heat by water body (calories);

\( u, v \) refer to flow velocity component at the direction of x, y (m/s);

\( K_x, K_y \) refer to turbulent dispersion coefficient at the direction of x, y (m²/s);

The heat exchange in MIKE21 model includes: input (output) heat of inflow (outflow); heat produced by precipitation; heat loss caused by evaporation of water; heat convection between water body and air; long and short wave radiation; heat exchange between underground water and surface water; heat exchange between riverbed and water body etc.. The main heat exchange processes considered in this environmental impact assessment and their expression of equation are as follows:

(1). Heat convection between water body and air

\[
q_v = \begin{cases} 
\rho_{air} C_{air} C_v W_{10m} (T_{water} - T_{air}) & \text{for } T_{air} > T_{water} \\
\rho_{air} C_{water} C_v W_{10m} (T_{water} - T_{air}) & \text{for } T_{air} \leq T_{water} 
\end{cases}
\]

Where, \( \rho_{air} \) refers to air density (kg/m³);

\( C_{air} \) refers to air heat capacity, 1007 \( J/Kg^\circ C \);

\( C_w \) refers to water heat capacity, 4186 \( J/Kg^\circ C \);

\( W_{10m} \) refers to wind speed (m/s);

\( T_w \) refers to temperature of water body (°C);

\( T_{air} \) refers to air temperature (°C);
$C_c$ refers to heat transfer coefficient $1.41 \times 10^{-3}$.

(2). Heat dissipation by evaporation

$$q_v = L C_e (\alpha_1 + b_1 W_{2m}) (Q_{\text{water}} - Q_{\text{air}})$$

Where, $L$ refers to latent heat of evaporation, $2.5 \times 10^8$ J/Kg;

$C_e$ refers to humidity coefficient, $1.32 \times 10^3$;

$W_{2m}$ refers to the wind speed 2m above the water surface (m/s);

$Q_{\text{water}}$ refers to the density of vapor near surface water (kg/(m$^2$S));

$Q_{\text{air}}$ refers to the density of vapor in air (kg/(m$^2$S));

$\alpha_1, b_1$ refer to empirical coefficients.

In MIKE21, the methods of QUICKEST, ULTIMATE, SIMPLE UPWIND and 2D UPWIND etc. are used for discretizing and solving the convection diffusion equation.

### 9.2.1.2 Simulation program

According to the analysis results of engineering, the warm water flow is $100 \times 10^4$ m$^3$/s; the difference between intake water and drain water is 7°C; the far-field simulation program is shown in Table 9.2-1.

<table>
<thead>
<tr>
<th>Program No.</th>
<th>Hydrological conditions</th>
<th>Location of sewage outfall</th>
<th>Emissions ($10^4$ m$^3$/s)</th>
<th>Discharge temperature (°C)</th>
<th>Environmental water temperature (°C)</th>
<th>Air temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neap tide in summer</td>
<td>Offshore discharge in deep water (-7m)</td>
<td>100</td>
<td>32</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>Neap tide in winter</td>
<td>Offshore discharge in deep water (-7m)</td>
<td>100</td>
<td>15</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Neap tide in summer</td>
<td>Discharge alongshore (-3m)</td>
<td>100</td>
<td>32</td>
<td>25</td>
<td>28</td>
</tr>
</tbody>
</table>
9.2.1.3 Analysis on simulation results

The far-field simulation results for every program are shown in the following diagrams.

Unit: °C

Maximal temperature-rise envelope line

Average temperature-rise isoline

Fig 9.2-1 Temperature-rise isoline diagram for simulation program 1 (summer offshore)
Average temperature-rise isoline
Fig 9.2-2 Temperature-rise isoline diagram for simulation program 2 (winter offshore)

Maximal temperature-rise envelope line

Average temperature-rise isoline
Fig 9.2-3 Temperature-rise isoline diagram for simulation program 3 (summer alongshore)

Maximal temperature-rise envelope line
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

Average temperature-rise isoline
Fig 9.2-4 Temperature-rise isoline diagram for simulation program 4 (winter alongshore)

Maximal temperature-rise envelope line

Average temperature-rise isoline
Fig 9.2-5 Temperature-rise isoline diagram for simulation program 5 (summer shoreside)

Maximal temperature-rise envelope line

Liuhe estuary
Shidongkou
Finished products wharf of Baosteel
From the diagrams we can see that, only the waters nearby the outfalls have been influenced by warm water discharge. The results of numerical simulation for each warm discharge program are show in Table 9.2-2, 9.2-3 and 9.2-4.

Table 9.2-2 Statistics for numerical simulation results of warm discharge under the conditions of offshore

<table>
<thead>
<tr>
<th>Simulation program</th>
<th>Simulation program, summer</th>
<th>Simulation program, winter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (m)</td>
<td>Width, max. (m)</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.05°C</td>
<td>760</td>
<td>80</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.1°C</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.2°C</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.5°C</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 1.0°C</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

Note: the “slash” in the table refers to the statistical length smaller than 40m of grid of the model or the statistical area smaller than 1600m²; the same as below.

Table 9.2-3 Statistics for numerical simulation results of warm discharge under the conditions of alongshore

<table>
<thead>
<tr>
<th>Simulation program</th>
<th>Simulation program, summer</th>
<th>Simulation program, winter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (m)</td>
<td>Width, max. (m)</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.05°C</td>
<td>1720</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>320</td>
<td>80</td>
</tr>
<tr>
<td>Average</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>
Table 9.2-4 Statistics for numerical simulation results of warm discharge under the conditions of shoreside

<table>
<thead>
<tr>
<th>Simulation program</th>
<th>Simulation program, summer</th>
<th>Simulation program, winter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (m)</td>
<td>Width, max. (m)</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.05°C</td>
<td>9760</td>
<td>400</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.1°C</td>
<td>2120</td>
<td>320</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.2°C</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 0.5°C</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Average temperature-rise ≥ 1.0°C</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

From the table we can see that the impact on the water temperature of nearby waters under the conditions of shoreside is greater than that of alongshore and offshore; the temperature-rise in winter is higher than that in summer. However regardless of programs selected, the area of waters near the outfall where the average temperature-rise ≥ 1.0 °C is less than 1600m².

9.2.2 Near-field simulation

PLUME model is used for the near-field simulation of warm discharge. This model comprises two computation models as RSB and UM with the function of computing the dilution of far-and near-field.

UM model belongs to Lagrange 2-demension plume model, it has two distinct characteristics: PAE for the Lagrange model and projection plane; Lagrange model makes it simpler and easier to handle PAE and at the same time, traditional Taylor entrainment assumption is adopted in the model.

The UM model can be used for simulating the vertical discharge of pollutants at arbitrary angle, downstream discharge of positive buoyancy, refluent discharge of negative buoyant, warm discharge and treatment of suspended particle in wastewater and background pollution.
9.2.2.1 Near-field simulation program

Table 9.2-5 The near-field simulation program for warm water drainage

<table>
<thead>
<tr>
<th>Program No.</th>
<th>Hydrological conditions</th>
<th>Location of sewage outfall</th>
<th>Emissions ($10^4 m^3/s$)</th>
<th>Discharge temperature ($^\circ C$)</th>
<th>Environmental water temperature ($^\circ C$)</th>
<th>Typical moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neap tide in summer</td>
<td>Discharge offshore</td>
<td>100</td>
<td>32</td>
<td>25</td>
<td>High slack water, low slack water, flood tide and ebb tide</td>
</tr>
<tr>
<td>2</td>
<td>Neap tide in winter</td>
<td>Discharge offshore</td>
<td>100</td>
<td>15</td>
<td>8</td>
<td>High slack water, low slack water, flood tide and ebb tide</td>
</tr>
<tr>
<td>3</td>
<td>Neap tide in summer</td>
<td>Discharge alongshore</td>
<td>100</td>
<td>32</td>
<td>25</td>
<td>High slack water, low slack water, flood tide and ebb tide</td>
</tr>
<tr>
<td>4</td>
<td>Neap tide in winter</td>
<td>Discharge alongshore</td>
<td>100</td>
<td>15</td>
<td>8</td>
<td>High slack water, low slack water, flood tide and ebb tide</td>
</tr>
</tbody>
</table>

9.2.2.2 Analysis on near-field simulation results

The numerical simulation results at typical moment for each program are shown in the following diagrams.
Fig 9.2-7 Simulation results for near-field warm water belt in Program 1 (discharge offshore in summer)
Fig 9.2-8 Simulation results for near-field warm water belt in Program 2 (discharge offshore in winter)
Fig 9.2-9 Simulation results for near-field warm water belt in Program 3 (discharge alongshore in summer)
Fig 9.2-10 Simulation results for near-field warm water belt in Program 1 (discharge alongshore in winter)
The vertical temperature change of warm water belt in different depth of the waters near the outfall for each program is shown in the following diagram.
10 Evaluation of the effects of the noise on the environment

10.1 Major Noise Sources

Based on the project analysis, the main noise source and others relating to the project are to receive noise reduction measures as shown in the Tab. 10-1.

Tab. 10-1 Project main noise source Unit dB(A)

<table>
<thead>
<tr>
<th>No.</th>
<th>Workshop</th>
<th>Procedural Equipment / Place involved in the noise</th>
<th>Intensity of the Noise Source</th>
<th>Preventive Measures</th>
<th>Reduced Intensity of the Noise Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corex steel making</td>
<td>Production Area</td>
<td>80~85</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Production Space</td>
<td>85~95</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outside the workshop</td>
<td>70~75</td>
<td></td>
<td>70~75</td>
</tr>
<tr>
<td>2</td>
<td>Midrex</td>
<td>Production Area</td>
<td>80~85</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Production Space</td>
<td>85~95</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outside the workshop</td>
<td>70~75</td>
<td></td>
<td>70~75</td>
</tr>
<tr>
<td>3</td>
<td>Steel-making Continuous casting shop</td>
<td>Electric furnace</td>
<td>120</td>
<td>Tight Cover</td>
<td>~85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smoke Discharge Fan within the dusting system</td>
<td>90~100</td>
<td>Muffler</td>
<td>~80</td>
</tr>
<tr>
<td>4</td>
<td>3500/2800mm Hot rolling and steckel mill workshop</td>
<td>Rolling line, shearing line, finishing line and heat treatment line</td>
<td>95</td>
<td>Architectural Partitioning due to enclosed type plant house</td>
<td>~80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combustion improving fan for the annealing furnace and heating furnace</td>
<td>90~95</td>
<td>Muffler and sound isolation cover</td>
<td>~80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High pressure water pump</td>
<td>95</td>
<td>Basement</td>
<td>~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noises outside the plant house</td>
<td>70~75</td>
<td></td>
<td>70~75</td>
</tr>
</tbody>
</table>
## Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Level</th>
<th>Noise Reduction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4,200mm Hot rolling and steckel mill workshop</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rolling line, shearing line, finishing line and heat treatment line</td>
<td>95</td>
<td>Architectural Partitioning due to enclosed type plant house</td>
</tr>
<tr>
<td></td>
<td>Combustion improving fan for the annealing furnace and heating furnace</td>
<td>90~95</td>
<td>Muffler and sound isolation cover</td>
</tr>
<tr>
<td></td>
<td>High pressure water pump</td>
<td>95</td>
<td>Basement</td>
</tr>
<tr>
<td></td>
<td>Noises outside the plant house</td>
<td>70~75</td>
<td>70~75</td>
</tr>
<tr>
<td>6</td>
<td>Lime workshop</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raw material crusher</td>
<td>80~90</td>
<td>Separation of sounds and vibrations</td>
</tr>
<tr>
<td></td>
<td>vibrating sieve</td>
<td>80~90</td>
<td>Separation of sounds and vibrations</td>
</tr>
<tr>
<td></td>
<td>Fan</td>
<td>85~95</td>
<td>Muffler</td>
</tr>
<tr>
<td>7</td>
<td>CCPP generating units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gas turbine unit</td>
<td>110</td>
<td>Sound isolation cover</td>
</tr>
<tr>
<td></td>
<td>Steam Outlet</td>
<td>110</td>
<td>Muffler</td>
</tr>
<tr>
<td></td>
<td>Steam Temperature and Pressure reduction device</td>
<td>110</td>
<td>Muffler</td>
</tr>
<tr>
<td>8</td>
<td>Oxygen station</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air compressor</td>
<td>100~110</td>
<td>Sound isolation cover, Architectural Partitioning</td>
</tr>
<tr>
<td></td>
<td>Gas compressor</td>
<td>100~110</td>
<td>Architectural Partitioning</td>
</tr>
<tr>
<td></td>
<td>Expansion engine</td>
<td>90~95</td>
<td>Muffler</td>
</tr>
<tr>
<td></td>
<td>Discharge of the pressurized gas</td>
<td>95~105</td>
<td>Muffler and sound reduction pit</td>
</tr>
<tr>
<td>9</td>
<td>Air compressor station</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Centrifugal type air compressor</td>
<td>120~130</td>
<td>Pipe Muffler, sound isolation by housing method</td>
</tr>
<tr>
<td></td>
<td>Air compressor station</td>
<td>85</td>
<td>Architectural Partitioning</td>
</tr>
<tr>
<td>10</td>
<td>Water plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outside the water pump</td>
<td>90</td>
<td>Architectural Partitioning</td>
</tr>
<tr>
<td>11</td>
<td>Central waste water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outside the blast fan</td>
<td>95</td>
<td>Architectural Partitioning</td>
</tr>
</tbody>
</table>
10.2 Mode Estimation

The estimated calculation will involve the recommended mode in the "Guidelines to the Technology for Evaluation of Effects on the Acoustic Environment".

(1) Acoustic sources outside

The following formula can be used to calculate the attenuation and divergence of the noise induced by its transmitted distance:

\[ L(r_2) = L(r_1) - 20\log \frac{r_2}{r_1} - \Delta l \]

Where:
- \( L(r_1) \) — the sound level at the distance \( r_1 \) from the acoustic source, dB(A);
- \( L(r_2) \) — the sound level at the distance \( r_2 \) from the acoustic source, dB(A);
- \( r_1 \) — the distance between the acoustic source and the recipient point \( 1, m \);
- \( r_2 \) — the distance between the acoustic source and the recipient point \( 2, m \);
- \( \Delta l \) — the value of attenuation by various factors including the sound barrier, blocking medium, and forestation and others.

(2) Acoustic source inside

① As is shown below, the double band sound pressure level at a certain point inside and near the enclosed structure shall be calculated as the first step:

\[ L_{oct,1} = L_{we, oct} + 10\log \left( \frac{Q}{4\pi r_1^2} + \frac{4}{R} \right) \]
Where:

Loct,1 — this is the double band sound pressure level of a certain acoustic source inside and near the enclosed structure.

Lw oct—this is the double band sound power level of a certain acoustic source;

r1—this is the distance between a certain acoustic source and the enclosed structure nearing it;

R—Room Constant;

Q—Direction factor

The total double band sound pressure level of all the acoustic sources inside and near the enclosed structure shall then be calculated.

\[
L_{oct,1}(T) = 10\log\left[\sum_{i=1}^{N} 10^{0.1L_{oct,1}(T)}\right]
\]

The sound pressure level shall be calculated outside and near the enclosed structure.

\[
L_{oct,2}(T) = L_{oct,1}(T) - (TL_{oct} + 6)
\]

The sound power level of the double band i, Lw oct shall be calculated once the Loct,2(T) and the transmitted area are converted into the equivalent acoustic source.

\[
L_{w\ oct} = L_{oct,2}(T) + 10\log S
\]
Where, S is the transmitted area, m².

⑤ The total sound pressure level shall be calculated.

Let the sound level A produced by the acoustic source i outside at the estimated point be \( L_{A_{in,i}} \), and let the working time of this acoustic source within time T be \( t_{in,i} \); Let the sound level A produced by the equivalent acoustic source j outside at the estimated point be \( L_{A_{out,j}} \), and let the working time of this acoustic source within time T be \( t_{out,j} \), and hence the total equivalent sound level at the estimated point is

\[
Leq(T) = 10 \log \left( \frac{1}{T} \sum_{i=1}^{N} t_{in,i} 10^{L_{A_{in,i}}/10} + \sum_{j=1}^{M} t_{out,j} 10^{L_{A_{out,j}}/10} \right)
\]

Where:

- \( T \) – time to calculate the equivalent sound level.
- \( N \) — the number of acoustic sources outside;
- \( M \) — the number of equivalent acoustic sources outside.

(3) Mode of superimposition of multi-acoustic sources

\[
L_0 = 10 \log \left( \sum_{i=1}^{n} 10^{L_{i}/10} \right)
\]

Where:

- \( L_0 \) — the total sound pressure level due to superimposition, dB(A);
- \( n \) — the number of acoustic source levels
- \( L_i \) — the sound pressure value of a certain point due to the acoustic sources.

### 10.3 Distance between the noise sources to different boundaries.

The nearest distance of all the noise sources to the different boundaries are as shown in the Tab 10-2.
Tab 10-2 Nearest distance of all the noise sources to the different boundaries (m)

<table>
<thead>
<tr>
<th>No.</th>
<th>Workshop/Equipment/(Place involved in the noise)</th>
<th>Nearest distance to the different boundaries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>1</td>
<td>Corex steel making workshop</td>
<td>240</td>
</tr>
<tr>
<td>2</td>
<td>Midex</td>
<td>900</td>
</tr>
<tr>
<td>3</td>
<td>Steel-making Continuous casting shop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electric furnace</td>
<td>1050</td>
</tr>
<tr>
<td></td>
<td>Smoke Discharge Fan within the dusting system</td>
<td>880</td>
</tr>
<tr>
<td>4</td>
<td>3500/2800mm Hot rolling and steckel mill workshop</td>
<td>1200</td>
</tr>
<tr>
<td>5</td>
<td>4,200mm Hot rolling and steckel mill workshop</td>
<td>1200</td>
</tr>
<tr>
<td>6</td>
<td>Lime workshop</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>CCPP generating units</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>Oxygen station</td>
<td>1100</td>
</tr>
<tr>
<td>9</td>
<td>Air compressor station</td>
<td>660</td>
</tr>
<tr>
<td>10</td>
<td>Water plant</td>
<td>2200</td>
</tr>
<tr>
<td>11</td>
<td>Central waste water treatment station</td>
<td>220</td>
</tr>
<tr>
<td>12</td>
<td>Stock yard</td>
<td>50</td>
</tr>
<tr>
<td>13</td>
<td>Waste steel site</td>
<td>1020</td>
</tr>
</tbody>
</table>

### 10.4 Estimated results

The contour lines due to the estimation of the noise are as shown in the Fig 10-1. The sketch showing the works boundaries are shown in the 10-2. Fig 10-3 summarizes the estimations of the noises at various boundaries. As is shown in the Fig. 10-3, the increased value ranges from 51.0 to 63.0dB(A) in terms of the noise intensity at various boundaries when the project in operation. In the daytime, the situation basically satisfies the requirements as Classification III zone under the “Standard for Noise at the Boundaries of an Industrial Business”. In the night time, the NW boundary basically satisfies the standard while the rest of the three boundaries exceed the standard to various degrees. The severest is the SW boundary where the maximum excess is 8.0dB(A) at the nighttime.
Fig. 10 – 2 Sketch showing the locations of the boundaries

Tab. Estimated results of the noises at the boundaries

<table>
<thead>
<tr>
<th>No.</th>
<th>Boundary</th>
<th>Estimated Value of the Noise (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NE Boundary</td>
<td>51.0~58.6</td>
</tr>
<tr>
<td>2</td>
<td>NW Boundary</td>
<td>51.0~54.7</td>
</tr>
<tr>
<td>3</td>
<td>SE Boundary</td>
<td>56.0~60.2</td>
</tr>
<tr>
<td>4</td>
<td>SW Boundary</td>
<td>53.0~63.0</td>
</tr>
</tbody>
</table>

10.5 Evaluation of the effects of the noise

(1) Effects of the noise on the boundaries

The evaluation results of the environmental effects of the project noise sources on the boundaries are shown in the Tab. 10-4.

Tab. 10-4 Evaluation results of the environmental effects of the project noise sources on the boundaries

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of boundary</th>
<th>Estimated value of boundary noise</th>
<th>Background Value</th>
<th>Superimposed Value</th>
<th>Standard value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>51.0~58.6</td>
<td>Daytime</td>
<td>Nighttime</td>
<td>Daytime</td>
</tr>
<tr>
<td>1</td>
<td>NE Boundary</td>
<td>51.0~58.6</td>
<td>51.2~58.4</td>
<td>43.8~51.2</td>
<td>54.1~61.5</td>
</tr>
<tr>
<td>2</td>
<td>NW Boundary</td>
<td>51.0~54.7</td>
<td>56.7~58.4</td>
<td>45.8~51.2</td>
<td>57.7~59.9</td>
</tr>
<tr>
<td>3</td>
<td>SE Boundary</td>
<td>56.0~60.2</td>
<td>51.2</td>
<td>43.8</td>
<td>57.2~60.7</td>
</tr>
<tr>
<td>4</td>
<td>SW Boundary</td>
<td>53.0~63.0</td>
<td>65.9</td>
<td>54.8</td>
<td>66.4~67.7</td>
</tr>
</tbody>
</table>

As is shown in the Tab. 10-4, in the daytime the sound level at different boundaries
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

will have less noticeable effects. Superimposed on the background value, NE, NW, and SE boundaries basically sustain the requirements as Classification III zone while the SW boundary basically satisfies the requirements as Classification IV due to the location being immediately in the vicinity of Yunchuan Road.

In the nighttime the sound level will have the effects to various degrees on the different boundaries. Superimposed on the background value, the sound level exceeds the standards to various degrees. NE, NW, and SE and SW boundaries are respectively 4.3dB(A)、1.3dB(A)、5.3dB(A) and 8.6dB(A) in excess of the standard. While analyzing the reason of the exceeded values, the oxygen station and Midex workshop are mainly responsible for the values at the NE boundary, and the hot rolling and steckel mill workshop is for the values at the NW boundary, and the lime workshop(Kiln) and CCPP generation machine are for the values at the SE boundary, and also the CCPP generation machine and the steel making continuous casting shop are for the values at the SW boundary.

(2) Effects on the sensitive objects

Seen from the project surroundings, there is the Chenghang reservoir across the protection forest in the North of 500 m, and Luojinggang District in the East, and in the South the other industrial lands of Shidongkou Economic Development Zone, and in the West the Baoshan Industrial Park across the Yunchuan Road. The nearest environmentally sensitive object is the Chenghang Town lying 1.3 km West by South of the Project boundary.

The project noises will have little effects on the sensitive objects that are too far from the works boundaries.

10.6 Countermeasures

The project noises mainly arise from the equipment involved in the production and technological processes as well as the fans, water pumps, air compressors and other mechanical facilities with the maximum noise level as high as 120dB(A). Seen from the estimated results, the noises produced by the mechanical equipment will have the effects on the boundaries at nighttime to various degrees. Hence the construction parties must strengthen the noise prevention and treatment by choosing the equipment of low noise and vibrations and blocking the channels by which the noise transmits, and further implementing the protective measures.

(1) The low noise and(or) vibration equipment shall be employed as it is possible while the muffler shall be installed on the equipment with the aerodynamic noise such as the fan for the dusting system, air exhauster in the continuous casting
machine, the fan for the heating furnace involved in the steel rolling system, air compressor, the compressor in the Oxygen station. Also the sound isolation cover shall be provide to the steam spray pump, Oxygen station, and air compressor station and other high noise equipment when the architectural partition shall be considered.

(2) A rational arrangement shall be carried out in the Works when some of the noisy equipment shall be placed inward within it. For example, it is recommended that the water pumps of the water factory, the sewage pumps and the blast fan of the sewage treatment works and others shall be placed at the side far from the boundary if the water factory and the sewage treatment station are laid out along the boundaries. The CCPP generation unit is too near to the boundary becoming the main noise source that leads to the unacceptable noises. Hence it is recommended that the CCPP generation unit be transferred to the middle area of the works or the land be requisitioned on a greater scale SE or SW of the unit.

(3) The more forestation shall be carried out along the boundaries. The high arbor and shrub shall be alternating with each other to form the hedgerow thus bettering the environment and reducing the noises. As a general rule the reductions can be 3-5dB(A).
Fig 9.2-11 The diagram for vertical water temperature change of waters near warm water outfall

From the diagram we can see that, the pinnate warm water belts form in near-field after discharge of warm water, and then they are mixed with water and elevated during dilution, while the water temperature drops drastically; the water temperature at the moment of flood tide and ebb tide, and 1.5-1.8°C for high and low slack water.

The influence extent of warm water discharge on the temperature of near-field waters is: low slack water, high slack water, ebb tide and flood tide. The comparison of near-field simulation results at the most unfavorable moment (low slack water) for each program is shown in Table 9.2-6.
Table 9.2-6 The comparison of simulation results for near-field waters

<table>
<thead>
<tr>
<th>Program No.</th>
<th>Hydrological conditions</th>
<th>Location of sewage outfall</th>
<th>Simulative moment</th>
<th>Temperature-rise value when the warm water belt moving up to water surface (°C)</th>
<th>The diameter of warm water belt up to water surface (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neap tide in summer</td>
<td>Discharge offshore</td>
<td>Low slack water</td>
<td>1.04</td>
<td>14.0</td>
</tr>
<tr>
<td>2</td>
<td>Neap tide in winter</td>
<td>Discharge offshore</td>
<td>Low slack water</td>
<td>1.06</td>
<td>15.1</td>
</tr>
<tr>
<td>3</td>
<td>Neap tide in summer</td>
<td>Discharge alongshore</td>
<td>Low slack water</td>
<td>1.67</td>
<td>10.1</td>
</tr>
<tr>
<td>4</td>
<td>Neap tide in winter</td>
<td>Discharge alongshore</td>
<td>Low slack water</td>
<td>1.72</td>
<td>10.2</td>
</tr>
</tbody>
</table>

From the temperature rise and area of warm water belt at the moment of low slack tide, the influence brought by alongshore discharge is greater than offshore discharge, and influence of discharge in winter is a litter greater than that in summer. This is the same with the conclusions under the conditions of far-field simulation.

At the moment of low slack water, the temperature of warm water belt will rise by 1°C when moving up to water surface under the conditions of offshore discharge, and the area is approx. 600-700 m²; for alongshore discharge, that is 1.7°C and 320 m² respectively.

9.2.3 Conclusions

(1) The far-field numerical simulation results of warm water discharge show that the influence of shore side discharge is greater than that of alongshore and offshore discharge; the temperature-rise in winter is higher than in summer. But no matter which kind of program, the areas of waters with average temperature-rise high than 1.0°C are less than 1600 m².

(2) The near-field numerical simulation results show that the pinnate warm water belts form in near-field after discharge of warm water, and the warm water belt moves up to water surface when mixing and diluting with surrounding water, while the water temperature drops drastically. At the moment of low slack tide, the temperature of warm water belt will rise by 1°C when moving up to water surface under the conditions of offshore discharge, and the area is approx. 600-700 m²; for alongshore discharge, that is 1.7°C and 320 m² respectively.
### 10 Evaluation of the effects of the noise on the environment

#### 10.1 Major Noise Sources

Based on the project analysis, the main noise source and others relating to the project are to receive noise reduction measures as shown in the Tab. 10 -1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Workshop</th>
<th>Procedural Equipment / Place involved in the noise</th>
<th>Intensity of the Noise Source</th>
<th>Preventive Measures</th>
<th>Reduced Intensity of the Noise Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corex steel making</td>
<td>Production Area</td>
<td>80~85</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Production Space</td>
<td>85~95</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outside the workshop</td>
<td>70~75</td>
<td></td>
<td>70~75</td>
</tr>
<tr>
<td>2</td>
<td>Midrex</td>
<td>Production Area</td>
<td>80~85</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Production Space</td>
<td>85~95</td>
<td>Architectural Partitioning</td>
<td>70~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outside the workshop</td>
<td>70~75</td>
<td></td>
<td>70~75</td>
</tr>
<tr>
<td>3</td>
<td>Steel-making Continuous</td>
<td>Electric furnace</td>
<td>120</td>
<td>Tight Cover</td>
<td>~85</td>
</tr>
<tr>
<td></td>
<td>casting shop</td>
<td>Smoke Discharge Fan within the dusting system</td>
<td>90~100</td>
<td>Muffler</td>
<td>~80</td>
</tr>
<tr>
<td>4</td>
<td>3500/2800mm Hot rolling</td>
<td>Rolling line, shearing line, finishing line and</td>
<td>95</td>
<td>Architectural Partitioning due to</td>
<td>~80</td>
</tr>
<tr>
<td></td>
<td>and steckel mill workshop</td>
<td>heat treatment line</td>
<td></td>
<td>enclosed type plant house</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combustion improving fan for the annealing</td>
<td>90~95</td>
<td>Muffler and sound isolation cover</td>
<td>~80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>furnace and heating furnace</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High pressure water pump</td>
<td>95</td>
<td>Basement</td>
<td>~75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noises outside the plant house</td>
<td>70~75</td>
<td></td>
<td>70~75</td>
</tr>
<tr>
<td>No.</td>
<td>Location/Unit</td>
<td>Equipment/Device</td>
<td>Noise Level</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------</td>
<td>--------------------------------------------</td>
<td>-------------</td>
<td>------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4,200mm Hot rolling and steckel mill workshop</td>
<td>Rolling line, shearing line, finishing line and heat treatment line</td>
<td>95</td>
<td>Architectural Partitioning due to enclosed type plant house</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combustion improving fan for the annealing furnace and heating furnace</td>
<td>90~95</td>
<td>Muffler and sound isolation cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High pressure water pump</td>
<td>95</td>
<td>Basement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noises outside the plant house</td>
<td>70~75</td>
<td>70~75</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lime workshop</td>
<td>Raw material crusher</td>
<td>80~90</td>
<td>Separation of sounds and vibrations</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>vibrating sieve</td>
<td>80~90</td>
<td>Separation of sounds and vibrations</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fan</td>
<td>85~95</td>
<td>Muffler</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CCPP generating units</td>
<td>Gas turbine unit</td>
<td>110</td>
<td>Sound isolation cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steam Outlet</td>
<td>110</td>
<td>Muffler</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steam Temperature and Pressure reduction device</td>
<td>110</td>
<td>Muffler</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Oxygen station</td>
<td>Air compressor</td>
<td>100~110</td>
<td>Sound isolation cover, Architectural Partitioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gas compressor</td>
<td>100~110</td>
<td>Architectural Partitioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expansion engine</td>
<td>90~95</td>
<td>Muffler and sound reduction pit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discharge of the pressurized gas</td>
<td>95~105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Air compressor station</td>
<td>Centrifugal type air compressor</td>
<td>120~130</td>
<td>Pipe Muffler, sound isolation by housing method</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air compressor station</td>
<td>85</td>
<td>Architectural Partitioning</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Water plant</td>
<td>Outside the water pump</td>
<td>90</td>
<td>Architectural Partitioning</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Central waste water</td>
<td>Outside the blast fan</td>
<td>95</td>
<td>Architectural Partitioning</td>
<td></td>
</tr>
</tbody>
</table>
10.2 Mode Estimation

The estimated calculation will involve the recommended mode in the “Guidelines to the Technology for Evaluation of Effects on the Acoustic Environment”.

(1) Acoustic sources outside

The following formula can be used to calculate the attenuation and divergence of the noise induced by its transmitted distance:

\[ L(r_2) = L(r_1) - 20 \log \left( \frac{r_2}{r_1} \right) - \Delta l \]

Where:
- \( L(r_1) \) — the sound level at the distance \( r_1 \) from the acoustic source, dB(A);
- \( L(r_2) \) — the sound level at the distance \( r_2 \) from the acoustic source, dB(A);
- \( r_1 \) — the distance between the acoustic source and the recipient point 1, m;
- \( r_2 \) — the distance between the acoustic source and the recipient point 2, m;
- \( \Delta l \) — the value of attenuation by various factors including the sound barrier, blocking medium, and forestation and others.

(2) Acoustic source inside

① As is shown below, the double band sound pressure level at a certain point inside and near the enclosed structure shall be calculated as the first step:

\[ L_{oct,1} = L_{ov, oct} + 10 \log \left( \frac{Q}{4\pi r_1^2} + \frac{4}{R} \right) \]
Where:

Loct,1 — this is the double band sound pressure level of a certain acoustic source inside and near the enclosed structure.

Lw oct — this is the double band sound power level of a certain acoustic source;

r1 — this is the distance between a certain acoustic source and the enclosed structure nearing it;

R — Room Constant;

Q — Direction factor

The total double band sound pressure level of all the acoustic sources inside and near the enclosed structure shall then be calculated.

\[
L_{\text{oct,1}}(T) = 10\log \left[ \sum_{i=1}^{N} 10^{0.1L_{\text{oct,1i}}(T)} \right]
\]

The sound pressure level shall be calculated outside and near the enclosed structure.

\[
L_{\text{oct,2}}(T) = L_{\text{oct,1}}(T) - (TL_{\text{oct}} + 6)
\]

The sound power level of the double band i, Lw oct shall be calculated once the Loct,2(T) and the transmitted area are converted into the equivalent acoustic source.

\[
L_{\text{w,oct}} = L_{\text{oct,2}}(T) + 10\log S
\]
The total sound pressure level shall be calculated.

Let the sound level \( A \) produced by the acoustic source \( i \) outside at the estimated point be \( L_{A_{in,i}} \), and let the working time of this acoustic source within time \( T \) be \( t_{in,i} \); Let the sound level \( A \) produced by the equivalent acoustic source \( j \) outside at the estimated point be \( L_{A_{out,j}} \), and let the working time of this acoustic source within time \( T \) be \( t_{out,j} \), and hence the total equivalent sound level at the estimated point is

\[
L_{eq}(T) = 10 \log \left( \frac{1}{T} \sum_{i=1}^{N} t_{in,i} 10^{0.1L_{A_{in,i}}} + \sum_{j=1}^{M} t_{out,j} 10^{0.1L_{A_{out,j}}} \right)
\]

Where:

- \( T \) – time to calculate the equivalent sound level.
- \( N \) — the number of acoustic sources outside;
- \( M \) — the number of equivalent acoustic sources outside.

(3) Mode of superimposition of multi-acoustic sources

\[
L_{0} = 10 \log \left( \sum_{i=1}^{n} 10^{L_{i}/10} \right)
\]

Where:

- \( L_{0} \) — the total sound pressure level due to superimposition, dB(A); 
- \( n \) — the number of acoustic source levels 
- \( L_{i} \) — the sound pressure value of a certain point due to the acoustic sources.

10.3 Distance between the noise sources to different boundaries.

The nearest distance of all the noise sources to the different boundaries are as shown in the Tab 10-2.
# Tab 10-2 Nearest distance of all the noise sources to the different boundaries (m)

<table>
<thead>
<tr>
<th>No.</th>
<th>Workshop/Equipment/(Place involved in the noise)</th>
<th>Nearest distance to the different boundaries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>1</td>
<td>Corex steel making workshop</td>
<td>240</td>
</tr>
<tr>
<td>2</td>
<td>Midex</td>
<td>900</td>
</tr>
<tr>
<td>3</td>
<td>Steel-making Continuous casting shop</td>
<td>880</td>
</tr>
<tr>
<td></td>
<td>Electric furnace</td>
<td>1050</td>
</tr>
<tr>
<td></td>
<td>Smoke Discharge Fan within the dusting system</td>
<td>1200</td>
</tr>
<tr>
<td>4</td>
<td>3500/2800mm Hot rolling and steckel mill workshop</td>
<td>1200</td>
</tr>
<tr>
<td>5</td>
<td>4,200mm Hot rolling and steckel mill workshop</td>
<td>1200</td>
</tr>
<tr>
<td>6</td>
<td>Lime workshop</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>CCPP generating units</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>Oxygen station</td>
<td>1100</td>
</tr>
<tr>
<td>9</td>
<td>Air compressor station</td>
<td>660</td>
</tr>
<tr>
<td>10</td>
<td>Water plant</td>
<td>2200</td>
</tr>
<tr>
<td>11</td>
<td>Central waste water treatment station</td>
<td>220</td>
</tr>
<tr>
<td>12</td>
<td>Stock yard</td>
<td>50</td>
</tr>
<tr>
<td>13</td>
<td>Waste steel site</td>
<td>1020</td>
</tr>
</tbody>
</table>

## 10.4 Estimated results

The contour lines due to the estimation of the noise are as shown in the Fig 10-1. The sketch showing the works boundaries are shown in the 10-2. Fig 10-3 summarizes the estimations of the noises at various boundaries. As is shown in the Fig. 10-3, the increased value ranges from 51.0 to 63.0dB(A) in terms of the noise intensity at various boundaries when the project in operation. In the daytime, the situation basically satisfies the requirements as Classification III zone under the “Standard for Noise at the Boundaries of an Industrial Business”. In the night time, the NW boundary basically satisfies the standard while the rest of the three boundaries exceed the standard to various degrees. The severest is the SW boundary where the maximum excess is 8.0dB(A) at the nighttime.
Fig. 10–2 Sketch showing the locations of the boundaries

Tab. Estimated results of the noises at the boundaries

<table>
<thead>
<tr>
<th>No.</th>
<th>Boundary</th>
<th>Estimated Value of the Noise (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NE Boundary</td>
<td>51.0~58.6</td>
</tr>
<tr>
<td>2</td>
<td>NW Boundary</td>
<td>51.0~54.7</td>
</tr>
<tr>
<td>3</td>
<td>SE Boundary</td>
<td>56.0~60.2</td>
</tr>
<tr>
<td>4</td>
<td>SW Boundary</td>
<td>53.0~63.0</td>
</tr>
</tbody>
</table>

### 10.5 Evaluation of the effects of the noise

(1) Effects of the noise on the boundaries

The evaluation results of the environmental effects of the project noise sources on the boundaries are shown in the Tab. 10-4.

Tab. 10-4 Evaluation results of the environmental effects of the project noise sources on the boundaries

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of boundary</th>
<th>Estimated value of boundary noise</th>
<th>Background Value</th>
<th>Superimposed Value</th>
<th>Standard value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daytime</td>
<td>Nighttime</td>
<td>Daytime</td>
</tr>
<tr>
<td>1</td>
<td>NE Boundary</td>
<td>51.0~58.6</td>
<td>51.2~58.4</td>
<td>43.8~51.2</td>
<td>54.1~61.5</td>
</tr>
<tr>
<td>2</td>
<td>NW Boundary</td>
<td>51.0~54.7</td>
<td>56.7~58.4</td>
<td>45.8~51.2</td>
<td>57.7~59.9</td>
</tr>
<tr>
<td>3</td>
<td>SE Boundary</td>
<td>56.0~60.2</td>
<td>51.2</td>
<td>43.8</td>
<td>57.2~60.7</td>
</tr>
<tr>
<td>4</td>
<td>SW Boundary</td>
<td>53.0~63.0</td>
<td>65.9</td>
<td>54.8</td>
<td>66.4~67.7</td>
</tr>
</tbody>
</table>

As is shown in the Tab. 10-4, in the daytime the sound level at different boundaries
will have less noticeable effects. Superimposed on the background value, NE, NW, and SE boundaries basically sustain the requirements as Classification III zone while the SW boundary basically satisfies the requirements as Classification IV due to the location being immediately in the vicinity of Yunchuan Road.

In the nighttime the sound level will have the effects to various degrees on the different boundaries. Superimposed on the background value, the sound level exceeds the standards to various degrees. NE, NW, and SE and SW boundaries are respectively 4.3dB(A), 1.3dB(A), 5.3dB(A) and 8.6dB(A) in excess of the standard. While analyzing the reason of the exceeded values, the oxygen station and Midex workshop are mainly responsible for the values at the NE boundary, and the hot rolling and steckel mill workshop is for the values at the NW boundary, and the lime workshop(Kiln) and CCPP generation machine are for the values at the SE boundary, and also the CCPP generation machine and the steel making continuous casting shop are for the values at the SW boundary.

(2) Effects on the sensitive objects

Seen from the project surroundings, there is the Chenghang reservoir across the protection forest in the North of 500 m, and Luojinggang District in the East, and in the South the other industrial lands of Shidongkou Economic Development Zone, and in the West the Baoshan Industrial Park across the Yunchuan Road. The nearest environmentally sensitive object is the Chenghang Town lying 1.3 km West by South of the Project boundary.

The project noises will have little effects on the sensitive objects that are too far from the works boundaries.

10.6 Countermeasures

The project noises mainly arise from the equipment involved in the production and technological processes as well as the fans, water pumps, air compressors and other mechanical facilities with the maximum noise level as high as 120dB(A). Seen from the estimated results, the noises produced by the mechanical equipment will have the effects on the boundaries at nighttime to various degrees. Hence the construction parties must strengthen the noise prevention and treatment by choosing the equipment of low noise and vibrations and blocking the channels by which the noise transmits, and further implementing the protective measures.

(1) The low noise and(or) vibration equipment shall be employed as it is possible while the muffler shall be installed on the equipment with the aerodynamic noise such as the fan for the dusting system, air exhauster in the continuous casting
machine, the fan for the heating furnace involved in the steel rolling system, air compressor, the compressor in the Oxygen station. Also the sound isolation cover shall be provide to the steam spray pump, Oxygen station, and air compressor station and other high noise equipment when the architectural partition shall be considered.

(2) A rational arrangement shall be carried out in the Works when some of the noisy equipment shall be placed inward within it. For example, it is recommended that the water pumps of the water factory, the sewage pumps and the blast fan of the sewage treatment works and others shall be placed at the side far from the boundary if the water factory and the sewage treatment station are laid out along the boundaries. The CCPP generation unit is too near to the boundary becoming the main noise source that leads to the unacceptable noises. Hence it is recommended that the CCPP generation unit be transferred to the middle area of the works or the land be requisitioned on a greater scale SE or SW of the unit.

(3) The more forestation shall be carried out along the boundaries. The high arbor and shrub shall be alternating with each other to form the hedgerow thus bettering the environment and reducing the noises. As a general rule the reductions can be 3-5dB(A).
11 Impact analysis of solid waste disposal

11.1 The source and amount of the solid waste

According to the engineering analysis, the solid waste mentioned in this project is from iron smelting system, steelmaking system, continuous casting system, rolling system and water treatment system. The source and amount of the solid waste are shown in following table 11-1.

Table 11-1: The source and amount of the solid waste in this project

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of solid waste</th>
<th>Source of solid waste</th>
<th>Output (ten thousand t/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corex ferric slag</td>
<td>Corex iron smelting system</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 1: 49.4</td>
<td>Stage 2: 98.8</td>
</tr>
<tr>
<td>2</td>
<td>Steel slag</td>
<td>Converter arc steel slag, electric arc furnace steel slag, top-floor re-injection</td>
<td>21.0</td>
</tr>
<tr>
<td></td>
<td>Of which: converter system</td>
<td>rotary hearth furnace steel slag</td>
<td>13.3</td>
</tr>
<tr>
<td></td>
<td>Electric furnace system</td>
<td>Stage 2: 60.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2: 26.5</td>
<td>Stage 2: 7.7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Desulphurizing of iron molten</td>
<td>Desulphurizing of iron molten in steel making system</td>
<td>0.75</td>
</tr>
<tr>
<td>4</td>
<td>Iron oxide powder</td>
<td>Continuous steel casting</td>
<td>2.2</td>
</tr>
<tr>
<td>5</td>
<td>Dust &amp; mud containing ferrite and collecting dust</td>
<td>Raw material charging system for mineral channel, coal channel in iron smelting system, top charging system, coal drying system, iron tapping area, furnace charging in steel making, converter arc steel fume, refining furnace fume etc.</td>
<td>9.5</td>
</tr>
<tr>
<td>6</td>
<td>Waste oil</td>
<td>Gathering in all workshops</td>
<td>0.02</td>
</tr>
<tr>
<td>7</td>
<td>Waste fire-retardant Materials</td>
<td>Blast furnace, iron molten ladle, iron tapping area, melting furnace, ladle</td>
<td>1.9</td>
</tr>
<tr>
<td>8</td>
<td>Sludge from waste water disposal (drying)</td>
<td>Water treatment devices in every workshop and central water treatment plant</td>
<td>0.78</td>
</tr>
<tr>
<td>9</td>
<td>Of which: sludge containing chrome</td>
<td>treatment device for waste water containing chrome</td>
<td>0.2</td>
</tr>
</tbody>
</table>
### 11.2 Classification of solid waste

Solid waste can be classified into five kinds: The sanitary rubbish, the waste from the society, medical waste, the usual solid waste from the factories and some dangerous waste. For this project itself, there are two classifications: that is the usual solid waste from the factories and some dangerous waste. Industrial solid waste can, based on the application form for the registration of pollutants disposal (trial), be divided into 9 classifications, when registered. That is (1) dangerous waste, (2) of which: medical waste, (3) smelting slag, (4) coal power, (5) slag, (6) gangue, (7) mill tailings, (8) radioactive waste (9) others.

The management of the handling the dangerous waste should be enhanced to avoid the environmental pollution caused by dangerous waste, to protect the environment and secure the people’s health. National Environment Protection Bureau, National Economics and Trade Committee, Foreign Economic and Trade Department and Public Security collectively constituted the national catalogue of dangerous waste, which became effective on July 1, 1998. Main 47 classifications of dangerous waste are listed in the catalogue.

### 11.3 The identification of solid waste

Eight classifications of solid waste are listed in this relocation project. Of all the eight classifications, Corex ferric slag, steel slag, slag from the desulphurizing of iron molten, mill scale, sludge containing ferrite and collecting dust, waste fire-retardant materials and industrial rubbish, sludge from waste water disposal are rather evident and they are included in the industrial solid waste. As to the waste oil, the waste mineral oil of the dangerous waste, by identification, refers to the HW08. The sludge containing chrome, which is listed in the dangerous waste catalogue, refers to, by identification, the waste mineral oil HW21.

The eight classifications of solid waste in this project, based on the identifications mentioned above, are divided into three kinds. See the table 11-2.
Table 11-2: Classifications of solid waste in this project

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of solid waste</th>
<th>Main ingredients</th>
<th>Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corex ferric slag</td>
<td>CaO, SiO₂, Al₂O₃, FeO, Fe₂O₃</td>
<td>Smelting slag</td>
</tr>
<tr>
<td>2</td>
<td>Steel slag</td>
<td>CaO, SiO₂, Al₂O₃, FeO, Fe₂O₃</td>
<td>Smelting slag</td>
</tr>
<tr>
<td>3</td>
<td>Desulphurizing of iron molten</td>
<td>CaO, SiO₂, Al₂O₃, FeO, Fe₂O₃</td>
<td>Smelting slag</td>
</tr>
<tr>
<td>4</td>
<td>Iron oxide powder</td>
<td>FeO, Fe₂O₃</td>
<td>The other slag</td>
</tr>
<tr>
<td>5</td>
<td>Dust &amp; sludge containing ferrite and collecting dust</td>
<td>Fe₂O₃, FeO and fixture carbon</td>
<td>The other slag</td>
</tr>
<tr>
<td>6</td>
<td>Waste oil</td>
<td>Petroleum oil</td>
<td>Hazardous waste material HW08</td>
</tr>
<tr>
<td>7</td>
<td>Waste fire-retardant Materials And industrial rubbish</td>
<td>SiO₂</td>
<td>The other slag</td>
</tr>
<tr>
<td>8</td>
<td>Sludge from waste water disposal</td>
<td></td>
<td>The other slag</td>
</tr>
<tr>
<td>9</td>
<td>Sludge containing chrome</td>
<td>Containing little chrome</td>
<td>Hazardous waste HW21</td>
</tr>
</tbody>
</table>

Apart from the industrial hazardous waste HW08, the waste oil, and the industrial hazardous waste HW21, the sludge containing chrome, the other slag refers to the industrial solid waste. Most of the usual industrial solid waste can be recycled.

**11.4 Solid waste disposal**

As for the solid waste caused by this project, Pu Steel Company carried out in its design recycling economic idea, by means of the source, decrease and harmlessness.

**Corex water slag**: its main chemical ingredients are CaO, SiO₂, Al₂O₃, nearly to the extent of blast furnest. The Corex water slag after water quenching in front of the furnace, can be wholly used as the raw material for making cement or as the silicate cotton with higher additional value of production or as mineral slag powder, and it can be used 100 percent in a comprehensive way.

**Steel slag**: electric arc furnace slag, electric furnace slag and refining furnace slag can be used to produce the slag building materials or used to build roads and fill pits, etc.
The slag from desulphurizing of iron molten: its main chemical ingredients are CaO, SiO2, Al2O3 and so on, consideration should be given, in the design, to the usage of Corex water slag for the production of material for the building material.

Dust and slag containing ferrite and collecting dust: Raw material charging system for mineral channel, coal channel in iron smelting system, top charging system, coal drying system, iron tapping area, furnace charging in steel making, converter arc steel fume, refining furnace fume etc brought out dust and slag containing ferrite and collecting dust. Consideration should be given to the transfer to Baoshan Iron Steel Group Company or to Sintering Plant of No 1 Steel Company as a part of production raw material to produce hot pellets, and the rate of its usage can be of 100 percentage. The actual operation can be trusted by Pu Steel Company to the Shanghai Pujiang Industrial Development Company (An affiliate of Baosteel Group Company). See Appendix.

Waste refractories: Main chemical compositions are SiO2, Al2O3, MgO, etc. The collected waste refractories can be used as the common building materials for large-size ones as well as pits filling and road building for small-size ones, also they can be recycled as raw material of refectories and slag-forming agent for steelmaking, so they can be comprehensively utilized to the extent of 100%.

Scale: the content of ferric oxide is about 71%, and it can be recycled for EAF steelmaking.

The sludge containing chrome: as to the sludge from the acid-containing waste water treatment by means of stainless steel acid cleaning, based on the analysis of experimental analysis on the toxicity leaching, nickel and fluoride concentration lower than (the identifying standard for hazardous waste(GB 5085. 1-3-1996)), but T-Cr pollutants concentration fluctuates to a rather extent (few analysis datum exceed the identifying standard for hazardous waste(GB 5085. 1-3-1996))), so they are hazardous waste and consigned to the working units which are qualified to handle the sludge containing chrome, with "permit for handling hazardous waste" given by Environment Protection Bureau of Shanghai City. Shanghai Pudong Chemical Factory is trusted to handle the sludge containing chrome specified in this project. Shanghai Pudong Chemical Factory owns the "permit for handling hazardous waste" with the permit certificate number 032, and it's a professional factory to handle sludge containing chrome and nickel. See Appendix.

Waste oil: Hazardous waste, and it will be handled by Shanghai Sanyi Industrial Company with the "permit for handling hazardous waste" with the permit certificate number 069 in this project. This company is professionally handling
utilizing mineral oils. See Appendix. See the table 11-3: The amount and the methods of comprehensive utilization of the solid waste in this project.

The amount and the methods of comprehensive utilization of the solid waste

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of solid waste</th>
<th>Output (ten thousand t/a)</th>
<th>methods of comprehensive utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Stage 1</td>
<td>Stage 2</td>
</tr>
<tr>
<td>1</td>
<td>Corex ferric slag</td>
<td>49.4</td>
<td>98.8</td>
</tr>
<tr>
<td>2</td>
<td>Steel slag</td>
<td>21.0</td>
<td>34.5</td>
</tr>
<tr>
<td>3</td>
<td>Desulphurizing of iron molten</td>
<td>0.75</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>Iron oxide powder</td>
<td>2.2</td>
<td>4.33</td>
</tr>
<tr>
<td>5</td>
<td>Dust &amp; sludge containing ferrite and collecting dust</td>
<td>9.5</td>
<td>15.3</td>
</tr>
<tr>
<td>6</td>
<td>Waste oil</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>7</td>
<td>Waste refractory and industrial rubbish</td>
<td>1.9</td>
<td>3.1</td>
</tr>
<tr>
<td>8</td>
<td>Sludge from waste water disposal</td>
<td>0.78</td>
<td>0.96</td>
</tr>
<tr>
<td>9</td>
<td>Sludge containing chrome</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

11.5 Impact analysis of solid waste disposal

As for the solid waste caused by this project, of which, the main is ferrite slag, steel slag and waste refractory, handled comprehensively and properly, Pu Steel Company carried out in its design recycling economic idea, by means of the source, decrease and harmlessness.

Therefore, the main impact of solid waste in Pusteel represents the surface occupation before its handling. Though they are common industrial solid waste,
they are likely to pollute the soils of the storage and the underground water in the surroundings as the result of raining; or there will probably be dust because of strong wind blowing, which may cause air pollution in the nearby environment. And so, it is recommended that the common solid waste in Pu Steel be piled on the basis of “Standard GB 18599-2001 for common industrial solid waste storage”.

- The storage place should be selected from the grounds which can be of anti-infiltration. The depth between the natural ground surface and underground water is no less than 1.5m. When the infiltration coefficient is more than $1.0 \times 10^{-7} \text{cm/s}$, natural or man-made materials should be used to build the ante-infiltration layer. The depth of the ante-infiltration layer should be nearly equal to the infiltration coefficient $1.0 \times 10^{-7} \text{cm/s}$, and the depth of clay infiltration should be 1.5m.

- Cofferdam should be set up in the surroundings; sprinkling should be adopted to avoid dust pollution to the environment.

- Water guiding channel and drainage system should be set up in the surroundings of the storage area to collect rainwater and then the handling can be managed at the wastewater treatment station.

- The hazardous waste oil and the sludge containing chrome have to be stored inside the house with Cofferdam and sunshade in the round container with warning marks. The storage area should comply with requirements specified in “Control Standard for hazardous waste storage (GB 18597-2001)”. 
12 Environment risk analysis

The environment risk analysis is an important part in the environment impact report for the project involving the production and application of chemical products.

The probability that the environment incident occurs is little, but the impact to the environment is extremely serious, and will bring the pollution to the environment and serious damage to the state property and people's lives.

The environment pollution incidents that shocking the world, of which, the most are caused by the incidents that broke out abruptly. For example, the poisonous gas pollution incident of Popal pesticide plant in Indian in 1984, the radioactivity pollution incident in the Soviet nuclear power station in 1986, and the Rhine pollution incident in the chemical store house of Basel, Swiss, etc. So are those incidents that occurred within China, the extraordinarily serious fire and the chemical products leakage. For example: The oil bunker fire incident in Yellow Island in Qindao on August 12, 1989, more than 40 thousand crude oil burned, more than six hundred crude oil overflew into the Jiaozhou bay, which caused the pollution of large sea area and led to the direct loss of 35.4 million yuan. The chemical products leakage incident in Shangrao on September 3, 1991, 595 people wounded and 39 people dead, the fire incident caused by the blast of hazardous goods in the store house in Shenzhen on August 5, 1993, 15 people dead, 25 people severely injured and 101 people hospitalized, and the direct economic loss is more than 250 million yuan. These incidents are typical cases that occurred abruptly and brought out severe consequence. In order to conduct the environment risk and impact analysis for the new project related to the production and application of large amount of hazardous chemical products, it is necessary to analyze the probability of the abrupt incidents and their hidden trouble, as well as the possible hazards and the precautions to be taken.

National Environment Protection Bureau issued the professional standard of environment protection (Technical Guide to Environment Risk Assessment in Construction Project (HJ/T 169-2004)) on December 11, 2004. This section deals with the project according to (Technical Guide to Environment Risk Assessment in Construction Project (HJ/T 169-2004))

This project is about a united iron & steel enterprise. In the production, large amount of coal gas in the iron smelting (carbon monoxide) will be brought. The coal gas is stored in the gas container, as the source of energy for CCPP generating electricity. The coal gas, after burning, will become carbon dioxide and its influence to the environment and human health can be controlled within the acceptable extent. But if there is some gas leakage or warning system failure, some unexpected incidents will happen — the leakage will certainly threaten the health of the people and the security of their lives, bringing environment pollution disaster.

This section describes the gas explosion, fire or hazardous incident caused by nature or human carelessness in the production, the emergency situations resulting from severe influence to the environment, the comprehensive assessment on the environmental problems and the precaution to be taken.
12.1 Assessment procedure

The risk assessment procedure for this project shall be conducted in accordance with the Technical Guide to Environment Risk Assessment in Construction Project (HJ/T 169-2004). For details, see Figure 12-1.

Figure 12-1  Flow chart of environment risk assessment
12.2 Risk identification

Large amount of coal gas will be brought out in the production, used mainly for CCPP generating electricity. In order to store and balance the Corex coal gas and the converter coal gas, 3 gasholders have been built, of which, one is 120m away from the border of the southeast plant, 400m away from the border of the southwest plant, and the other two are equally 700m away from the border of the two plants. The overall dimension of the 3 gasholders:

Table 12-1: storage capacity and overall dimension of the gasholders

<table>
<thead>
<tr>
<th>gasholder</th>
<th>Kinds of coal gas</th>
<th>Storage capacity 10 thousand m³</th>
<th>Diameter (m)</th>
<th>Height (m)</th>
<th>Pressure of coal gas (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1#</td>
<td>Corex coal gas</td>
<td>15</td>
<td>52</td>
<td>73</td>
<td>10</td>
</tr>
<tr>
<td>2#</td>
<td>Corex coal gas</td>
<td>10</td>
<td>45</td>
<td>67</td>
<td>10</td>
</tr>
<tr>
<td>3#</td>
<td>Converter coal gas</td>
<td>8</td>
<td>58</td>
<td>47</td>
<td>3</td>
</tr>
</tbody>
</table>

Compositions of coal gas stored in the gasholders, see Table 12-2.

Table 12-2: main compositions and heat value of different gases

<table>
<thead>
<tr>
<th>Kinds of coal gas</th>
<th>CO (%)</th>
<th>CO₂ (%)</th>
<th>H₂ (%)</th>
<th>N₂ (%)</th>
<th>CH₄ (%)</th>
<th>Others (%)</th>
<th>Calorific value (kJ/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corex coal gas</td>
<td>42.0</td>
<td>30.0</td>
<td>17.0</td>
<td>2.0</td>
<td>2.0</td>
<td>7</td>
<td>7842</td>
</tr>
<tr>
<td>Converter coal gas</td>
<td>58.5</td>
<td>15.1</td>
<td>3.7</td>
<td>21.5</td>
<td>1.0</td>
<td>0.2</td>
<td>8200</td>
</tr>
</tbody>
</table>

According to Identification of Source of Major Risk (GB 18218-2000), the flammable coal gas (carbon monoxide and hydric mixture) is the source of major risk, and its critical quantity is 10t. The total amount of carbon monoxide is about 200t, overtopping excessively limit in Identification of Source of Major Risk (GB 18218-2000), therefore, gas holders are the source of major risk in the storage area in this project.

12.2.1 Identification of coal gas risk

The major ingredient of coal gas is carbon monoxide. Its molecular weight is 28.1, melting point -199.1°C, the boiling point -191.1°C, the top limit and the lower limit of the explosion are 74.2% and 12.5% respectively. Coal gas is an acromatic and smell-less gas that is easy to burn and explode. The mixture of coal gas and air will burn or explode in case of burning fire or high temperature. Identification of risk number 21005.

The hazard of coal gas to the health represents mainly the hypoxia because of the mixture of coal gas and blood hemoglobin in the blood. Slightly acute poisoned will have a symptom of headache, dizziness, tinnitus, palpitation,
nausea, vomit, inability. The concentration of carboxyhaemoglobin in the blood may be higher than 10%. The concentration of carboxyhaemoglobin in the blood of the severely acute poisoned may be higher than 50%. Some of the poisoned may have the belated encephalopathy.

Therefore, this section focuses on analyzing the leakage risk of carbon monoxide (coal gas).

12.2.2 The standard of CO working site and the standard of environment quality.

According to the standard The Limit of Contacting the Hazardous Matters in the Professional Working Site (GBZ 2-2002), the allowable value of the concentration of carbon monoxide within 8 hours in the working site is 20mg/m3 (TWA), the allowable value of the concentration of carbon monoxide within 15 minutes in the working site is 30mg/m3 (STEL). The secondary daily average value in Environmental air quality standard is 30mg/m3.

12.3 Risk analyzing of coal gas in storage and transportation

12.3.1 Hidden hazard in the process of storage and transportation

In case of the storage of coal gas produced and used in this project is improper, the hazard is most likely to happen. In general, there are the following scenario:

1) If management in the storage of coal gas is improper or fails to meet the requirements, the gas leakage will occur, resulting in the poisoning incidents of injury and death.

2) If leakage of coal gas in storage occurs, fire or explosion will happen in case of reaching the limit value of explosion or encountering high temperature and open fire.

Hidden hazard in the process of production

Gas leakage is the major risk in the process of production in this project. There are two major situations in the fire or explosion caused by gas leakage, one is the impact of external factor, the other is that production process is abnormal.

1) Hidden hazard caused by the external factor

When water supply or power supply fails, or if there are some emergencies or irresistible natural disasters, gas pipes are likely to bend or break and coal gas leakage will occur, resulting in all kinds of incidents. When weather changes, especially, when there is a fire outside the gas container, the temperature will rise abruptly, the coal gas inside the gas container will expand, resulting in gas leakage or explosion.

2) Hidden risk caused by the abnormality in the production process
If there is a sudden interruption of CCPP in the production, and that iron smelting continues, there will be addition of coal gas into the gas container, resulting in the increase of pressure, and the gas leakage follows and the incident will occur.

12.4 Probability investigation of risk

1) History of coal gas production in Shanghai

The first gas plant in Shanghai was built in Road Xizan and supplied gas in the year of Tongzhi 4, Qin Dynasty (1865). The production came to a stop in the year of Minguo 23 (1934). The second gas plant was built and began to supply gas in the year of Tongzhi 6, Qin Dynasty, and the production came to a stop in the year of Guangxu 17, Qin Dynasty. The third gas plant, Yangshupu gas plant, was built and put into operation in February of the year Minguo 23. The forth gas plant, Wusong gas plant, was built and began to produce gas in November of the year Minguo 29. There were two coal gas plants until Shanghai liberation in 1949. The total sales volume was 298.3 million m³.

The first helix gas container in Shanghai was built on September 25, 1985. The first-stage construction of Wujin coking plant (The current Shanghai coking plant) was built in 1959, Pudong coal gas plant in 1991 and Shidongkou coal gas plant in 1996. During the same period, Yangshupu coal gas plant and Wusong coal gas plant expanded many times carbonized oven, coke oven and water gas oven, and developed heavy oil catalysis, craking gas making and light oil gas making. The gas making capacity has increased greatly. The total sales volume in 1995 reached 1536.19 million m³, an increase of 50.98 times of that in 1949.

2) Investigation of gas container accidents in Shanghai

The investigation in Shanghai Coal Gas Company reveals that no gas explosion accidents have been reported in Shanghai City, either, no accidents of gas leakage in the gas container resulting in injury or death. The accidents that the poisoning coal gas resulted in the death of people were caused mainly by coal gas leakage inside the house. There are several decades of those accidents.

3) Investigation of gas container accidents in iron & steel plant

On January 15, 2004, the gas container of North Steelmaking Company Limited in Jixi City suddenly burned, the height of the gas container is 34.32m, the diameter is 42m, the capacity is 30,000 m³ and there was 20,000 m³ gas stored. The daily gas leakage amount due to the corrosion of shell reached over 10,000m³, during the welding, the leakage gas burned, the ignition point was at the bottom of the No.3 floor tower of the gas container and the distance above the ground is 18m. As the pressure of gas in the container is very high, the flame at the leakage spurt outside and the radiation heat wave spreaded to around one hundred meter and injured some workers. No explosion owing to the timely rescue.

On the afternoon of September 10, 2004, there was a fire at the transformer station in the power plant of Shuicheng Iron & Steel Company (group) Limited. 2 hours after the fire, the 30000m³ coal gas container in the combustible gas
workshop of the power plant exploded. Fortunately, there was no injury or death of people, owing to the workers' relief of shift. The cause of this accident has something related to the fire 2 hours before at the transformer station in the power plant of Shuicheng Iron & Steel Company.

### 12.5 Analysis and assessment of the accident consequence

#### 12.5.1 Forecast mode

While forecasting the risk, the impact forecast of the assuming accidents can be carried out by using the multi-puff mode in Technical Guide to the Risk Assessment, and analyzing the extent and the scope of the impact.

#### 12.5.2 Forecast parameter confirmation

**Parameter confirmation**

Assuming that, in the storage, there is a crack opening caused by corrosion in the CO coal gas container, the state of gas leakage can be estimated by using the following formula according to The Mode of Risk Assessment and its Application.

$$\frac{P_0}{P} \leq \left(\frac{2}{k + 1}\right)^{\frac{k}{k + 1}} \quad (1)$$

$$\frac{P_0}{P} \phi \left(\frac{2}{k + 1}\right)^{\frac{k}{k + 1}} \quad (2)$$

In the formula,

- $P_0$ —— environment pressure, Pa
- $P$ —— medium pressure, Pa;

$$\frac{P_0}{P} \phi \left(\frac{2}{k + 1}\right)^{\frac{k}{k + 1}}$$

$k$ —— heat insulation index, namely constant pressure heat capacity to constant volume

If CO leakage meets the formula (1) mentioned above, the amount of gas leakage can be estimated according to the following formula:

$$Q_0 = C_{d} A P \sqrt{\frac{M_k}{RT} \left(\frac{2}{k + 1}\right)^{\frac{k}{k - 1}}}$$
Q0 —— gas leakage speed, kg/s;

Cd —— gas leakage index;

A —— crack opening acreage, m2 ;

M —— relative molecular mass;

R —— gas constant, J/ (mol. k);

T —— gas temperature, K.

Calculating by gas leakage speed formula:

When the diameter of crack opening is 0.1 m, the amount of CO leakage is 0.6 kg/s, the amount of 2 hour leakage is CO 4320 kg, equivalent to the amount of CO 3456 m3 .

12.5.3 Forecast mode

As to the instant or short time accident, the multi-puff mode can be used in the following changeable weather:

\[
C_w'(x, y, o, t_w) = \frac{2Q'}{(2\pi)^{3/2} \sigma_x \sigma_y \sigma_z \exp\left(-\frac{H_c^2}{2\sigma_x^2}\right) \exp\left(-\frac{H_c^2}{2\sigma_y^2}\right)} \exp\left(-\frac{H_c^2}{2\sigma_z^2}\right)
\]

In the formula:

\[Q'\] The amount of puff leakage (mg), \(Q' = Q\Delta t; Q\) is rate of discharge (mg. s -1), \(\Delta t\) is the section time limit (s);

\[\sigma_x, \sigma_y, \sigma_z\] When the puff goes at the w time section in the direction of x, y, and z, its equivalent diffusion parameter (m) can be calculated by the following formula:

\[
\sigma_{j, eff}^2 = \sum_{k=1}^{\infty} \sigma_{j,k}^2 \quad (j = x, y, z)
\]

In the formula:
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

\[ \sigma_{j,k}^2 = \sigma_{j,k}^2(t_k) - \sigma_{j,k}^2(t_{k-1}) \]

\[ x_w^i = u_{x,w}(t-t_{w-1}) + \sum_{k=1}^{w-1} u_{x,k}(t_k - t_{k-1}) \]

\[ y_w^i = u_{y,w}(t-t_{w-1}) + \sum_{k=1}^{w-1} u_{y,k}(t_k - t_{k-1}) \]

-\{\}\- and when \( y_w^i \)- is at the \( w \) time section, the \( x \) and \( y \) coordinate at the \( i \) center of puff mass can be calculated by the following two formulas:

The concentration contribution of every puff at the attention \( t \) hour can be calculated by the following formula:

\[ C(x, y, 0, t) = \sum_{i=1}^{n} C_i(x, y, 0, t) \]

In the formula, the number of puffs, \( n \), to be followed, can be calculated by the following formula:

\[ C_{w+1}(x, y, 0, t) \leq f \sum_{i=1}^{n} C_i(x, y, 0, t) \]

In the formula, \( f \) is the index smaller than 1, and it can be confirmed by the formula.

12.5.4 Forecast results

Forecast results of coal gas leakage can be see in Table 12-3.

<table>
<thead>
<tr>
<th>Leakage time</th>
<th>30 minutes</th>
<th>60 minutes</th>
<th>90 minutes</th>
<th>120 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate conditions</td>
<td>D stability / 1m/s</td>
<td>D stability / 3.4m/s</td>
<td>D stability / 1m/s</td>
<td>D stability / 3.4m/s</td>
</tr>
<tr>
<td>distance</td>
<td>D stability / 1m/s</td>
<td>D stability / 3.4m/s</td>
<td>D stability / 1m/s</td>
<td>D stability / 3.4m/s</td>
</tr>
</tbody>
</table>

Table 12-3: Forecast results of coal gas accidents under different weather conditions in different time. Unit: mg/m3.
12.5.5 analysis of accident impact

The damage of concentration of CO to people, see Table 12-4.

<table>
<thead>
<tr>
<th>(mg/m³)</th>
<th>Ppm</th>
<th>Time of exposure</th>
<th>Damage to people</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>3.2</td>
<td>All-day</td>
<td>(Standard of Air Quality in the Environment) The secondary daily average value of concentration in the</td>
</tr>
<tr>
<td>20</td>
<td>16</td>
<td>8 hour</td>
<td>(The Limit of Contacting the Hazardous Matters in the Professional Working Site (GBZ 2-2002)): the allowable value within 8 hours within 15 minutes</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td>37.25</td>
<td>30</td>
<td>8 hour</td>
<td>The allowable max value (Japan)</td>
</tr>
<tr>
<td>87.5~125</td>
<td>70~100</td>
<td>1 hour</td>
<td>The max value in big cities, the central nervous system may be damaged.</td>
</tr>
<tr>
<td>150</td>
<td>120</td>
<td>1 hour</td>
<td>The allowable max value in a short time (Japan)</td>
</tr>
<tr>
<td>250</td>
<td>200</td>
<td>2/4 hour</td>
<td>Heavyness in the front of the head, slight headache</td>
</tr>
<tr>
<td>625</td>
<td>500</td>
<td>2/4 hour</td>
<td>Severe headache, nausea, failure, visual disturbance</td>
</tr>
<tr>
<td>1250</td>
<td>1000</td>
<td>2/3 hour</td>
<td>Tachycardia, spasm, be of one’s head</td>
</tr>
<tr>
<td>2500</td>
<td>2000</td>
<td>1/2 hour</td>
<td>Death occurrence</td>
</tr>
</tbody>
</table>

Thus it can be shown in the table, that when there is leakage from crack opening of 0.1m dia, the concentration nearby the leakage at 100m (inside the company)
is about 200mg/m³. With increase of distance, the concentration is smaller, and at 500m, the concentration smaller than 8 hour limit specified in The Limit of Contacting the Hazardous Matters in the Professional Working Site (GBZ 2-2002), not harmful to people. At 1100m, the concentration even smaller, much lower than the secondary daily concentration in Environmental air quality standard.

Chenhan Town is 1300m away from the boundary in this project, 2500m away from gas holder, and Shengqiao Town 2300m away from the boundary in this project.

But with the amount mentioned above, the leakage accidents will affect the people inside the company. Severe impact may come into being with short distance.

12.6 Preventive measure and emergency strategy

12.6.1 Preventive measure

As stated in the assessment of the risk analysis, coal gas leakage is the major accident most likely to happen in this project. Preventive measure is to eliminate the factors that lead to these accidents. At the start of this project, preventive measure should have priority. In taking the preventive measure, consideration should be given to technical requirements as well as to the reliable preventive system.

As to the accidents in this project, some consideration in the design of the project has been given to the fact that gas holders have to be built in an independent unit, with a detector nearby the main pipe, and if coal gas leaks, the auto warning is available. With the sprinkling fire extinction device fixed, the device is started once there is leakage.

Recommended that the project company enhance the following preventive measures, with the facilities as preventive measure.

(1) Supervised by top managers in the company and the local government (including environment protection administration and fire control departments), HSE management system has to be set up and operated. A perfect HSE system is to be set up and operated strictly.

(2) The vital premise is that sufficient knowledge and mastery of physicochemical property of coal gas help manage leakage accidents properly. It has to be known that after gas leakage the situation without open fire is more dangerous than the situation with open fire. Tragic accidents are more likely to happen. In dealing with the accidents, considerations should be given to different situations.

(3) A construction site has to be located in a proper place, there has to be some distance between gas holders and the workshops. A buffer zone has to be left and cannot be occupied and it must be approved by fire extinction department.
(4) Enhance labor protection and safety in production. The coal gas is transported from iron smelting system to the CCPP and the coal gas holders, the testing and detecting devices at the joints and valves of pipes have to be fixed and the valves can be shut promptly to ensure safety in people and production.

(5) Supervision in the construction has to be enhanced to ensure that the infrastructure and facilities (pipes and valves) in the construction project accord with design specification and quality requirements. After operation, the company should set up a perfect and strict system of equipment maintenance and management to find the problems and avoid the accidents and minimize the loss.

(6) On-the-job training enhancement. On-the-job training is vital, employees have to know their own operating rules and the corresponding emergency measures. At the start of construction, the experienced technicians are needed to be in charge of the accidents most likely to happen. Therefore, on-the-job training of the operators should be conducted before the start of construction to reduce the accidents. Furthermore, the training and daily education of operators is vital to standard operation, maintenance of industrial facilities, safety assurance, and the invest of training implies safety, as well as the smooth operation and high output.

(7) Supervision in operation is to be enhanced by means of responsibilities at different levels, a perfect patrol rule and standard operation. Above all, on night shift.

(8) Suggested that there is some buffer facility at the boundary in every section, so that each pipe can be separated immediately from the other pipe or gas holder when gas leaks. And the accident impact can be minimized.

(9) While the gas holder examined and repaired, people in charge of safety and environment protection and so forth must be on the site, and the relevant departments are informed to rush to deal with an emergency.

12.6.2 contingency planning

While in the state of an emergency, anything possible has to be taken to minimize the accident impact.

(1) when there is an accident, contact as soon as possible the department of fighting and preventing natural calamities in Shangha City, to minimize the accident impact, with the help of the society.

(2) First-aid medicine, such as isomyl nitrite, potassium permanganate solution or hyposulphite solution and so forth has to be available. While in the state of acute intoxication accident, artificial respiration, when necessary, chest or back press respiration, not mouth to mouth respiration can be taken.

(3) Besides the professional fire company, there will be volunteer firemen. They are trained regularly and each can use fire apparatus properly.
(4) While in the state of fire or explosion, contact immediately the general manager, fire company, department of environment and safety, section of equipment and telephone exchange. The devices and equipments have to be separated timely and the joints and valves have to be cut off.

(5) The telephone exchange, when informed, should notice immediately the relevant departments: water supply, gas supply, power supply and health station to rush and save the injured. All departments gather together immediately, jump through a hoop and cooperate actively to save life and property.

(6) While in the state of accident, the department of safety should organize immediately people to maintain the order in the surroundings of the accident, each and every department should maintain its own order. Irrelevant people are not allowed to enter the accident site to ensure that firemen rush to an emergency smoothly.

(7) Within ten minutes after the explosion or fire, the department of safety should block all the gates. Except fire engine, ambulance, trucks carrying fire-fighting apparatus and materials, Irrelevant people are not allowed to enter the company, and meanwhile more patrol in and outside the company to ensure safety and check.

(8) While in the state of accident, all employees must stick to their post and jump through a hoop.

12.7 Brief summary

(1) Pusteel is a large size iron & steel united company, the 3 gas holders (total capacity 330 thousand m3) are identified to be the major cause of risk in the storage area in this project.

(2) The investigation in Shanghai Coal Gas Company reveals that no gas explosion accidents have been reported in Shanghai City, either, no accidents of gas leakage in the gas container resulting in injury or death. The accidents that the poisoning coal gas resulted in the death of people were caused mainly by coal gas leakage inside the house.

(3) By estimation, when there is some leakage from a crack opening of 0.1 dia, the major impact is inside the company, on the people inside the company. Severe impact may come into being within short distance. The impact is little on the residents outside the company 2km away in Chenhan town, Shengqiao town.
13 Assessment of ecological environment effects

Ecosystem is the mutual dependence relationship between life-forms and non-life-forms on the land surface. Nature is not a separated unity of life-forms (including animals, plants, microorganism and human beings) and non-life-forms (such as land, water, and climate) which depend on and check each other mutually. The transform and exchange of energy between life-forms and non-life-forms constitute a system of motion of matter, which is the ecosystem.

In order to evaluate the impact of a construction project on the ecological environment, the following three aspects shall be included: (1) Investigation of the ecological environment to some extent in project construction area, including topography and geomorphic feature, hydrology, climate that may not have been effected by human activities or that may have been effected to some extent; the species, number, and distribution of wild animals and plants; the kinds, number of crops and farming life-stocks; land usage, types and amount of vegetation, soil quality; Whether there are some rareness, animals and plants in danger or extinct, nature reserves or special habitats declared by an international organization, the government or some departments. (2) Analysis of the potential impact of the project in construction and operation on the ecosystem (including animal species and the habitats) Pertinent measures have to be taken to facilitate the protection and management of the ecosystem.

13.1 Assessment of the current situation of the regional ecosystem

13.1.1 The current situation of the land ecosystem

The removal project of Pusteel is scheduled to be built in Luojin town, Baoshan district of Shanghai City, an occupation of area 2.82km², under the administration of Yuepu town and Luojin town. The planned construction site is mostly countryside, with a little land available for a company. The current situation of the ecosystem is pretty good; each and every aspect of the ecosystem is as follows:

13.1.1.1 The topography and geomorphic feature

The geomorphic feature of the planned construction site is in the old seaside plane, and the earthiness is clay. The physiognomy is plane, ground elevation is between 2.8m and 4.1m and the average ground elevation is 3.86m.

13.1.1.2 Land area ecosystem

(1) vegetation

The species of land area in the planned construction site is abundant, including farmland vegetation, wild vegetation and landscaping, etc.
Farmland vegetation: currently most of the area in the construction site is farmland and vegetable fields, with little scattering of residents. Plants in the vegetable field are mainly spinach, broccoli, cauliflower, cabbage, turnip, garlic, leek, sherry, etc; horse bean, ground nut, sword bean and so on are leguminous plants in the planned construction site; rape and so on is the most usual crop in the area.

Wild vegetation: A lot of weeds scatter nearby the villages, around the pools, along the riversides, around the farmlands, in the deserted area, in the fields and on the ridge of field, along the roadsides in the planned construction site. Several decades of herbal plants are growing there, the major of them are grass family and feverfew, and many of them are weeds of different kinds. Not a peculiar plant can be found here, many plants are foreign and naturalized species; the system of land area vegetation is affected greatly by human activities. The species of weeds is rather simple in the well-managed farmland, but rather complicated in the farmland not well-managed.

Landscaping: Few landscaping plants in the planned construction area, the major of the plants, the usual white poplar, little-leaf box, fossil tree, cypress and paper mulberry can be found often in Shanghai. A small quantity of cannas and scarlet sage, etc is planted in the farmers’ garden plots. On both roadsides and riversides are mainly natural weeds, with small quantities of different natural trees and roadside trees.

13.1.1.3 Terrestrial animal

The animal ecosystem where the project is built is well-protected, with dispersed of large quantities of yellow weasel, south China hare, hedgehog, and some other wild animals. Cattle, sheep, rabbits, dogs and cats can be found in the natural villages. Large quantities of rodent there on the farmland and in the farm-houses; Except for some poly-verrucas wall geckos, dinodon rufodorsata pallas, etc, the creepers are fewer; The quantity of amphibian is fewer, most of them can be seen in Shanghai.

The agricultural ecosystem in the construction area is well-protected, with a great variety of birds, such as accipitridae, falconidae, wikipedia, lark, laniidae, the number of lark is fairly big; sparrow, barn swallow, red-rumped swallow, etc can be found in the residential areas. But in the construction area, some birds, such as quails and pies, affected by the polluted water in the fields and rivers, are in severe danger.

13.1.2 Water area ecosystem

13.1.1.4 Water quality status

According to the testing data of the surface water quality in the environment, the quality of water in Xinchuansha river, Xisuitang river, Beidalian river, Yangsheng
river and Panjin river which run through the construction area can reach virtually the level IV in Environmental quality standards for surface water (GB 3838—2002). But the content of NH3-N in the water of Xisuitang river, Yangsheng river and Panjin river go beyond the level IV; except for the content of COD, NH3-N, TP, petroleum in Yangtz section in this project can reach the level III, the others can reach the level II.

13.1.1.5 The status of aquatic life-forms in inland river

There is an advanced network of inland rivers in the construction area, and a lot of pools and water ecosystem is excellent.

In this area, the main aquatic higher plant in the water body is reed-wild rice community. Reed community is distributed mainly along riversides, in the water splash zone of rather deep pools and in all low pools, very different from the background. Rather than the reed, wild rice community (wild can shoot) is distributed in deeper water, usually around the reed community.

Large quantities of plant plankton in the water body, and can be found often in Baoshan area, such as, Enteromorpha, Colacium, Nanicula, Chlamydomonas, Scenedesmus, Sicractinium, Closterium, Ankistrodesmus corda, Cryptomonas, Synedra, Melosira, Cymbella, Merismopedia; Zooplankton is usually a kind of Protozoan and Wheel animalcule (Brachionus calyciflorus Pallas, Brachionus forficula, Filinia brachiata, Syncheata, Polyarthra, Weisse, Brachionus quadridentatus, Brachionus angularis Gosse, Copepod and Cladocerans, etc.)

Fewer species of zoobenthos are in the water body and they are small quantities of cellula analis, shellfish, and easily found in Shanghai.

13.1.1.6 The aquatic ecosystem in the Yangtze section in this project

(1) Phytoplankton

- Number of species and composition

Compared with the other water areas, the species number of phytoplankton in this area is rather small, between 1~10×10^4/m3. The main species of phytoplankton are Skeletonema costatum, Melosira granulate, Coscinodiscus oculus-iridis, Pediastrum simplex var.duodenarium, Microcystis aeruginosa, Skeletonema costatum is predominant in number, amounting 39.8% of the total, Melosira granulate is next, amounting 22.21% of the total, and the fresh water species is about 50%, see the table 13-1.

The species and composition of phytoplankton and Carassius auratus

<table>
<thead>
<tr>
<th>The species and composition</th>
<th>Carassius auratus</th>
</tr>
</thead>
</table>
Types of ecosystem

The main is fresh water community, low salinity community close to the sea comes next. In reference to ecology propensity of phytoplankton, there are three communities:

Low salinity community at the river mouth and close to the sea: this community is distributed vastly in offshore and in shore of Temperate Zone, the representative is Skeletonema costatum, Coscinodiscus oculusiridis, Spinosus, Coscynodiscus jondsiarius, Coscinodiscus argus, N. sigma var. intercedens and Cerataulus favus, etc. Due to the unique of the geographic position and changeable hydrologic condition, there is a variety of this community, (about 29%), the number is 33%.

Mid sea high salinity community: this community is distributed vastly in mid sea of Temperate Zone, the representative is Chaetoceros lorenzianus and Pyrophacus horologicum v. steini. The species of this community is fewer (5%), the scarcity is 1%, coming in with the tide by chance.

Fresh water community: the representative is Melosira granulate and Pediastrum simplex var. duodenarium Rab and Microcystis aeruginosa of Wikipedia and Chlorophyta. There is a variety of this community, running along with the Yangtze River, distributed in a large area, the species (about 65%) and the number (about 56%).

Analysis of diversity index

The average value of diversity index is 2.40, changing between 1.86 and 3.20; the average evenness is 0.64, changing between 0.52 and 0.86; the average abundance is 0.77, changing between 0.44 and 0.93; the average singlet is 0.29, changing between 0.14 and 0.47. Diversity index of phytoplankton is fairly large, the evenness and the abundance large, the singlet small, the formation of the community stable, and the water body affected slightly.

(2) Zooplankton

Biomass and specific composition

The average biomass of zooplankton is 44.77mg/m3. By investigation of appraisal, the total number of zooplankton in this water area is 16 (including 5 juvenile and fry), all belong to crustacean, of which the prime is copepoda, 7 species, amounting 43.75 of the total, the other only 1 species. The abundance of
The species and composition of zooplankton and the abundance in all species (piece/m3)

<table>
<thead>
<tr>
<th>group</th>
<th>Ecology index</th>
<th>Average value</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>cladocerans</td>
<td>1</td>
<td>1.60</td>
<td>1.58</td>
</tr>
<tr>
<td>copepoda</td>
<td>7</td>
<td>93.60</td>
<td>92.17</td>
</tr>
<tr>
<td>Amphipod</td>
<td>1</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Decapods</td>
<td>1</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Mysids</td>
<td>1</td>
<td>3.96</td>
<td>3.90</td>
</tr>
<tr>
<td>Apostichopus japonicas</td>
<td>5</td>
<td>2.21</td>
<td>2.17</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>101.55</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Types of ecosystem

The investigation will be focused on the water area of internal river at Yangtze River mouth and Koumen water area, the results show that the community architecture of zooplankton is very simple, the dominant is fresh water species, with little brackish water outfall ecologic community and low salinity near shore ecologic community.

Fresh water ecologic community: this community is distributed along Yangtze internal river, with the most of the species in this area investigated. The dominant is Moina micrura, Sinocalanus dorrii, Neodiaptomus schmackeri and Mesocyclops heuckarti and etc.

Brackish water outfall ecologic community: the prime of this community is Schmackeria poplesia, the other is Monoculodes limnophilus, and the number is small.

Low salinity near shore ecologic community: the dominant is Tortanus vermiculus in this water area investigated. The others are Labidocera euchaeta and Acanthomysis longirostris, etc.

Analysis of diversity index

In reference to the statistics, the average diversity index (H) in the water area nearby the Yangtze River in this project is smaller than 1, and the index of evenness and the abundance is extremely small. It is shown from the comprehensive ecological indicators that the species of zooplankton in the water area investigated is simple, the dominance of the dominant species is rather evident, and the dominant species is overwhelming, especially the species and quantity of zooplankton are little, representing the diversity is relatively poor, the
community architecture is unstable, and is not suitable for the existence of zooplankton.

(3) Zoobenthos

In reference to the appraisal of bed mud sample in the area investigated, there are 5 species of Zoobenthos. Of all, 2 species of Annelid are the dominant, 2 species of Mollusk, 1 species of Crustacean, Corbicula fluminea and Nephtys californiensis Hartman are the dominant species. See the table 12-3. Monitoring of the bed mud Zoobenthos in the water area shows the species is sparse, and the number is extremely small. The community architecture is very simple, implying the environment of the bottom nature is very unfavorable for the existence of Zoobenthos in the water area monitored. Zoobenthos ranks very highly in the aquatic ecosystem, not only is the feedstuff of the higher aquatic animals, also plays an important role in the coupling of river mouth productivity, the aquatic system and the demarsal system, and the water body food web. The sole species of Zoobenthos reveals the function of the aquatic ecosystem architecture has been destroyed in this area.

Species of Zoobenthos and analysis of individual density and biomass

<table>
<thead>
<tr>
<th>group</th>
<th>species</th>
<th>Individual density (species/m²)</th>
<th>Biomass/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>The average value</td>
</tr>
<tr>
<td>Annelid</td>
<td>2</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Mollusk</td>
<td>2</td>
<td>40</td>
<td>16.25</td>
</tr>
<tr>
<td>Arthropod</td>
<td>1</td>
<td>20</td>
<td>3.75</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>30.00</td>
<td>120</td>
</tr>
</tbody>
</table>

(4) Fish resources

In reference to the information in 1980’s, fish eggs and young fry that have been appraised in the Yangtze River mouth is of 100 fish species in 54 bagridaes. Fish eggs, joey and young fry samples were collected on March 8, 1997, 9 species of which have been appraised, 9 bagridaes in 6 items, another 3 species were sampled to genus, 1 species was sampled to family. Perciformes 6 species, 46%; Clupeiformes 3 species, 23%; the other 4 items, 1 species respectively. The species of fish eggs, joey and young fry at the Yangtze River are decreasing remarkably in the past years. Stolepharus chinensis, Coilia mystus, Tridentiger trigonocephalus Erythrocnlter mongolicus in numbers are distributed vastly in this area. No spawning ground and habitats of rare fishes and economic fishes are near the water area of warm water drainage from Pusteel.
13.2 **Assessment of the current situation in the ecosystem**

In reference to the investigation, mainly in the planned construction area is the farmland ecosystem. In the area investigated, there are no animals and plants or rare animals in extinction that have to be protected nationally. Neither are there special habitats and special species.

13.3 **Analysis of the impact on the ecosystem**

13.3.1 The impact on the land ecosystem in this project construction

1. The impact of this project on the ecosystem in the previous location

The previous location of Pusteel is in the district of Zhoujiadu Pudong Shanghai, very close to Huangpu River, with area of 2.18m^2, a water front of 1820m. The whole location of the land is within World Expo 2010 Shanghai arena to be built, 40% of the Expo land usage.

The pre-existence of Pusteel was No. 3 Iron & Steel Plant, a 90 year-old enterprise with out of date production process and equipment. Although with constant efforts of changing production structure and promoting cleaning operation in the past years, the situation of environment protection can hardly be improved greatly. Dust discharge in operation affects the surroundings to some extent. Planting area in the company is only 250000m^2, ratio of green space only 11.8%.

The space after Pusteel removal will be used as the arena of Expo. "Better city, Better life" and "Green Expo" is the importance of the idea of World Expo 2010 Shanghai. The improvement of environment and ecosystem, the spread of greening idea and the formation of an ecosystem city will be valued greatly in the planning of Expo. No doubt, Pusteel’s removal, with the construction of Expo arena, will improve significantly the ecosystem of Pusteel’s pre-existence and its surroundings.

2. The impact on the land ecosystem in this construction site

1. Change of the land utilization

The change of the land utilization in the construction site before and after the completion of project is shown in Table 13-4. Seen from Table 13-4, the farmland, counting 63% of the total area, will be utilized mainly in the construction site. After the completion of the project, this land, counting 90% of the total area has turned into industrial land. The farmland and the farmers’ inhabitation will have virtually disappeared, with a slight addition of water area.

Table 13-4: the planned style change of the land utilization round about the project construction.
### Nature of land usage

<table>
<thead>
<tr>
<th>Nature of land usage</th>
<th>The current state</th>
<th>Plot</th>
<th>Fluctuation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Ratio (%)</td>
<td>Area</td>
</tr>
<tr>
<td>Farmland</td>
<td>1.78</td>
<td>63.1</td>
<td>-</td>
</tr>
<tr>
<td>Land for construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmland</td>
<td>0.30</td>
<td>10.6</td>
<td>-</td>
</tr>
<tr>
<td>Road land</td>
<td>0.07</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>Industrial land</td>
<td>0.47</td>
<td>16.7</td>
<td>2.54</td>
</tr>
<tr>
<td>Water area</td>
<td>0.2</td>
<td>7.10</td>
<td>0.28</td>
</tr>
<tr>
<td>Total area</td>
<td>2.82</td>
<td>100</td>
<td>2.82</td>
</tr>
</tbody>
</table>

I The change of water coverage

In reference to the current state of the land utilization in this planned area, the main water area is XiSuitanghe River, Suitanghe River, Xiejiabing and Nanmaojiatang, etc. The water coverage is about 7.1% of the total area; after the construction, the water system in the construction will be refine-tuned, the current water system will be filled with a new Suitanghe canal, and the water coverage is about 10% of the total area, a slight addition of water coverage.

I Greening area will be increased.

According to Preliminary Feasibility Report for Relocation of Pusteel of Baosteel Group in Luojing Project, after the completion of the project, the greening area will reach 700800m², and the green land coverage will reach 30%. The large-area man-made greening will be formed in the plant area, the mild vegetation spreads with rough and tumble in the village area will be changed, and the local ecologic environment will be thereby greatly improved.

I The diversity of plants and animals is decreasing.

Because the crops in the planned construction site will disappear, the problem is the single species of man-made planting, low maturity, single plant cover, and the diversity of plants is generally decreasing.

The food chains, depending on the crops, of crop-pest-frog-snake and crop-field mouse-bird will change greatly, and the animals will leave the area in the planned construction site. Furthermore, the domestic animals and poultry that live in the nature villages will be less and the diversity of animals will decrease because the animals (house mouse, sparrow, swallow) that live together with people lose the ecosystem in which they exist.

But the construction site of this project is not included in the area of environment protection; the project construction will not destroy the ecosystem or change the nature of the index of bion, species, biome and biome structure in the planned construction area.
13.3.2 Impact of waste water drainage in the project on the aquatic ecosystem of the Yangtze River

The amount of waste water drainage is 62400 m$^3$/d; the treated waste water reaching the standard is discharged into the Yangtze River, through the outlet of the pipe-rear at Shidongkou Wastewater Treatment Plant. Shidongkou Wastewater Treatment Plant is one of the large size wastewater treatment plants in Shanghai, with a designed ability of treating 400000 m$^3$, the mode of tail water drainage is alongshore discharge (400m off the shore, 5m depth of water).

According to Shanghai Environment Protection Administration Water Environment Function Planning (revised), dilution zone is designed to be at the alongshore water area, in the waste water treatment plants at the Yangtze River mouth and in Hangzhou bay, with an ability of treating daily 100000 m$^3$ drainage.

According to the assessment of environment impact at Shidongkou Wastewater Treatment Plant, the drainage at Shidongkou Wastewater Treatment Plant will not, in normal time, intensify the deterioration of ecosystem at the Yangtze River mouth. Both the yearly monitoring and the test operation of the project have shown no deterioration of section water quality at Shidongkou, not quite different from the other section waters. The amount of drainage in the project is much smaller than that at Shidongkou Wastewater Treatment Plant, the dilution zone of tail water drainage at Shidongkou Wastewater Treatment Plant is available, and the prediction results have shown that the drainage in the project may increase very little pollutants in the Yangtze River. Therefore, the drainage into the Yangtze River in the project is to be managed at the tail water pipe at Shidongkou Wastewater Treatment Plant, and will not destroy basically the ecosystem at the Yangtze River mouth.

13.3.3 Analysis of the impact of warm water discharge on the Yangtze River aquatic ecosystem

(1) Impact on the physicochemical property of water body

<table>
<thead>
<tr>
<th>Impact on dissolved oxygen</th>
</tr>
</thead>
</table>

The state of dissolved oxygen in the water environment decides to a significant extent the activities of aquatic life, and dissolved oxygen is one of the indispensable matters in the process of metabolism. The research has shown that the relevant coefficient between water temperature and dissolved oxygen is very high. When the water temperature rises from 0℃ to 40℃, the contents of T and DO are negatively correlated. When the temperature rises per 6℃ ~ 10℃, the content of DO decreases within 0.5 and 3.0 mg/l. When the temperature rises to 35℃, the content of DO remains higher than 5.0 mg/l. When the temperature is lower than 40℃, the dissolved oxygen is higher than 4.0 mg/l. That is, in general, the temperature increase that causes the change of dissolved oxygen can still
meet the lowest dissolved oxygen demand of fish. But in reservoir the temperature rise causes the water layering, and the content of dissolved oxygen is very low in deep water, and it should be concerned.

The initial temperature of warm water discharge at Pusteel is $7 \, ^\circ C$ than the environment; the initial temperature in summer $32 \, ^\circ C$, the initial temperature in winter $15 \, ^\circ C$. Owing to the large quantity of the fast current in the Yangtze River, the discharged warm water will be mixed and diluted very soon. When the temperature is $\geq 2.0 \, ^\circ C$, the maximum diameter in the water area is $8.5m$; and when the average temperature rise is $\geq 1.0 ^\circ C$, the water area is smaller than $1600m^2$. Therefore, the temperature rise in the nearby waters after warm water entering the Yangtze is not evident; no water body layering, the content of dissolved oxygen in the water body in the discharged water area remains nearly the same, and even the aquatic life will not be harmed because of the lack of oxygen.

Impact on the other physiochemical property

The harm of non ion ammonia to the aquatic life. The content of non ion ammonia is rising with the temperature rise, and the relevant equation is:

$$A = 0.042e^{0.417T}, r = 0.98.$$  

In the equation: $A$ is concentration, $T$ is temperature, $r$ is the relevant coefficient.

Warm water discharge may make the water color pollution, poor transparence, increase of the ammonia and nitrogen content, the intensified mineralization degree of water quality, the content of the total phosphorus and total nitrogen on the high side and the process of eutrophy in the discharged water area accelerated. However, with the same situation in the dissolved oxygen, the warm water discharge in Pusteel will not change greatly the content of non ion ammonia and the other physiochemical property in the water.

(2) Impact on plankton

If the water temperature is raised 2 degree, the species and quantity of alga in the received water body area will be thereby changed. Under the high temperature, the number of blue algae and green algae can be increased, to the contrary, the number of diatom will be decreased remarkably. Blue algae and green algae manifold in great number for a long time every year, restraining the growth of the other food organism, and their biomass is overwhelming. Warm water discharge will prolong the growth of algae, make it vigorous, and speed up endogenesis nutrient disintegrating in bed mud and aggravate eutrophy in water body. The growing speed of algae is in positive correlation with temperature rise in a certain area and in negative correlation with the diversity of algae, and the change of the correlation is quite different with the change of seasons. It is only with the enough temperature rises, the discharged water area and enough impact time that warm
water discharge will accelerate water body eutrophy evidently.

According to the relevant research results, when temperature within 20°C and 50°C, and when temperature is 30°C, the number of plankton species and the coefficient of the diversity reach the maxmum. The number of rotifer is at the very most, at 40°C, and the number of copepoda is at the very most, at 30°C.

It is shown that the average temperature rise in the large area (1km²) after warm water discharge at Pusteel is lower than 0.1°C, far from the critical 2°C temperature rise that will cause the change of plants families. The temperature rise 3 meters below the water surface (the main distribution area of plankton) is lower than 2°C. There is no spreading of blue algae and green algae, causing the structure change of plankton families. There is no adverse impact on the plankton families, and even the temperature rise will help increase the biomass and diversity of plankton.

(3) Impact on zoobenthos

The animals that inhabit on the ground surface or in the layers of bed mud are inactive. Because of poor trans-energy, these animals are easily impacted adversely, not being able to avoid the attack of warm water discharge.

It is shown from the study on the impact of warm water discharge in Xiangtan Heat and Power Plant on the good-sized dermarral invertebrates that in high heating area (temperature rise above 6°C), no zoobenthos was found at the spot of the samples; in mild heating area (temperature rise around 4°C), 16 species of zoobenthos were found, and the dominant species is arthropod, counting for 69%, and the next is annelid, the dominant species is the five pulse midge, counting for 33%; in low heating area (temperature rise below 2°C), 11 species of zoobenthos were found at the spot of samples, the dominant species is arthropod, counting for 55%, however, annelid counting for 18%. By comparing the percentages of samples, it is shown that the proper temperature rise is favorable to the increase of species and number of arthropod.

In view of the fact that the dayfly, cikubtail, Gammarus, water boatman, caudal gill, crob shell will disappear in the heating area, they are sensitive to the rise of temperature, however, most midge will exist in the heating area, the species that enjoy temperature rise. Therefore, the species that are sensitive to temperature rise will disappear in the heating area, the whole fauna makeup is changing in favoring of the species enjoying the temperature and enduring the low dissolved oxygen. No samples of any species were collected in the high heating area, it can be thought that the temperature rise of 6°C above the natural water body mean harm to zoobenthos, even in winter. On the contrary, 4°C temperature rise helpful to the zoobenthos. Under the lower natural water temperature, the temperature rise is more helpful to the zoobenthos, within certain temperature changes. Low heating also helpful to the increase of diversity.
The natural temperature during the period of July and September is above 26℃, the highest temperature will be 30℃, so under the high temperature, animals' growth is restricted and they may die if the temperature is raised. So, the impact of warm water discharge on zoobenthos during summer end and mid-autumn is not remarkable. The area where animals decrease greatly will be expanded to the mild heating area. However, in the other seasons, under the 26℃ natural water temperature, the abundance of zoobenthos in the low heating area will be greater than that in the natural water body.

When the temperature is raised, the metabolism in the animal body is speeding, with an increase of oxygen consumption. But dissolved oxygen in water body is decreasing with temperature rise in different situations, which is not helpful to the existence of zoobenthos. This shows that zoobenthos disappear in high heating area and decrease in the habitats because of the warm water discharge.

It is shown that it is only in high heating area that good-sized species of zoobenthos will be impacted greatly and adversely. By comparison, the effect of warm water discharge in Pusteel, is less evident than that in Xiangtang Heat and Power Plant, and the surrounding water area after the impact of warm water discharge is basically in low heating area, the diameter of mild heating area is 4m or so, only a very small area of diameter smaller than 3m at the outlet of discharge pipe is in the high heating area. Thus, the good-sized species of zoobenthos are nearly not impacted diversely in their growth, and in the certain area, both biomass and diversity of zoobenthos are increasing.

(4) Impact on fishes

In the surface layer water, the temperature is the most important environmental factor of the impact on fishes. After the warm water entering the received water area, the species of the families will change because the normal distribution of fishes and the aquatic life changes. In different heating areas, fishes are impacted to a different extent. Generally when temperature rise is high than 3℃, the impact is evident. For example, after the operation of Dayawan Nuclear Station, young fish of Allanetta bleekeri disappeared, and the number of lickee cod is decreasing rapidly, and some change of species is lagging effect; when temperature rise is lower than 3℃, the impact is helpful to fishes. In a certain area, the number of species is increasing with temperature rise, more fishes migrating in and less fishes migrating out. Individuals are also increasing. 3℃

The study shows that the evident impact of warm water discharge on fish breeding is in the water area of surroundings, and the impact on the existence and distribution is not remarkable. Fishes prefer to lay eggs on the edge of heating area (1.0℃) than in the water area where the temperature rise is above 1.0℃. Impact of warm water on the death rate of young fishes is not evident, according with research results in Japanese Ocean biological environment Research Institute. It has been found in the study of relationship between the
nuclear power warm water discharge and fishery that plankton will not change basically from cooling water pipe intaking to warm water discharging; fishes and seashell after intaking can endure warm water 7℃ above the environment because of short time stay in the pipe, so the impact is not evident.

The Chinese Academy of Fishery Sciences has made a sampling survey of 65 fishes aquatic animals in the main rivers in China, acute thermal impact test, thermal avoiding test, maximum starting death temperature and lasting thermal effect test and histology check up, discussing the temperature standard for impact of waste thermal discharge in the Chinese fishery water area on fishes. It is believed that 36℃ is the highest temperature of waste thermal discharge in summer in Zhujian and Zhanjian water area; 35℃ in the Yangtze River, Qiantangjian and Huanghe water system; 26℃ in Helongjian and Songhuajian water system; 24℃ in Dalian bay offshore water area and 21℃ in cold water fish water area in northwest China. The biggest water temperature change range in all water systems is not allowed to exceed ±3℃.

So, there are very little effects caused by temperature rise in warm water discharge at Pusteel. The maximum diameter of the area where the change of water temperature is above 3℃ after warm water discharge in the surrounding water body is only 5.8m. In a larger area (1k2), the average temperature rise is lower than 0.1℃, both the highest temperature and the temperature change in the largest area are lower than the required, without any adverse impact on fish existence and breeding.

Summing up: Warm water discharge area is the coast area in Baoshan district at the Yangtze River mouth. There is a long history of development, and all kinds of industrial areas and ports. Human activities have impacted the situations in tidal flat–wetland, presenting the signs of pollution, incomplete ecosystem and poor diversity of aquatic life. The most usual aquatic life can be found in the river mouth area. There are no breeding areas and habitats of rare animals in this area, no special ecologic sensitive objects that have to be protected with great care and the sensitiveness of aquatic ecology is general. The amount of warm water discharge at Pusteel is 1000000 m3, and the water temperature is 7℃ higher than the surrounding. But it is the vast amount of flush flow at the Yangtze River mouth and the unique force tide ecologic characters at Hekou area that determines the fast spreading after warm water discharge, resulting in no evident temperature rise heating nearby the discharge pipe area. The average temperature rise in the area of 1km2 is lower than 0.1℃, not resulting in evident temperature rise heating in the water body, and not presenting a diverse impact on the aquatic ecosystem and water quality change. The impact on the aquatic ecosystem, see Table 13-5.

Table 13-5: Analysis of the impact of Pusteel warm water discharge on ecosystem
<table>
<thead>
<tr>
<th>Eco-factor</th>
<th>Temperature rise range</th>
<th>Potential impact on ecosystem</th>
<th>Effects of Pusteel warm water discharge</th>
<th>Effect prediction of aquatic ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical and chemical factor</td>
<td>Dissolved oxygen</td>
<td>Water temperature and dissolved oxygen in negative correlation, resulting in oxygen lack of aquatic life</td>
<td>Dissolved oxygen in water body slightly impacted, not resulting in oxygen lack damage of aquatic life</td>
<td>The average temperature rise in a large area (1km2) lower than 0.1°C</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>Thick water, poor transparency, intensified total salinity, too large content of total phosphorus and total nitrogen</td>
<td>Not resulting in evident effects</td>
<td></td>
</tr>
<tr>
<td>Eco-factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plankton</td>
<td>Above 2°C</td>
<td>Increase of blue algae, green algae and decrease of diatom</td>
<td>≤8.5</td>
<td>Not resulting in a diverse impact on plankton families</td>
</tr>
<tr>
<td></td>
<td>Below 2°C</td>
<td>Increasing biomass and diversity of plankton</td>
<td>&gt;8.5</td>
<td></td>
</tr>
<tr>
<td>Zoobenthos</td>
<td>Above 6°C</td>
<td>Presenting great impact on plankton</td>
<td>≤2.9</td>
<td>The good-sized species of zoobenthos slightly impacted, and in the certain area, both biomass and diversity of zoobenthos increasing</td>
</tr>
<tr>
<td></td>
<td>4°C or so</td>
<td>In the lower natural temperature area, heating more helpful to the increase of species and number of zoobenthos</td>
<td>2.9-8.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Below 2°C</td>
<td></td>
<td>≥8.5</td>
<td></td>
</tr>
<tr>
<td>fishes</td>
<td>Above 3°C</td>
<td>Evident damage to fishes</td>
<td>≤5.8</td>
<td>In case of the highest temperature</td>
</tr>
<tr>
<td>Below $3^\circ$C</td>
<td>Number of species increasing with the temperature rise</td>
<td>&gt;5.8</td>
<td>temperature and variation of water temperature is limited in the specified value; there shall be no adverse impact on fishes' existence and breeding.</td>
<td></td>
</tr>
</tbody>
</table>

### 13.4 Ecologic environment protection measures

(1) Anti pollution plants shall be chosen

As there is a lot of dust in local area in Lojin, Baoshan, covering the surface of tree leaves, reducing photosynthesis; Particles also block the venting holes, reducing air permeability. Even a particle with size of 5 to 10 micron can enter plant cells, cause necrosis of cellular system, and thus prevent the growth of plants.

The appropriate plant species for greening shall be selected at the construction stage. In general, consideration should be given, first, to anti-pollution, poisonous intaking, air purifying, sound insulating, sun shading, then, to certain ornamental, and also to the greening plants that can adapt the requirements of the local climate, soil and hygiene.

The anti-pollution trees with excellent resistance that can grow in Shanghai should be selected. The following trees can be planted in the company: privet, phoenix tree, mock orange, rosebay, elm, tree of heaven, acacia, imperial, chinor, coral, southern magnolia, etc. The tall, evergreen, broad-leaved arbors are planted, and the recommended: aroma scent, southern magnolia; the evergreen, broad-leaved frutex are planted, and the recommended: rosebay, mock orange, distylium racemosum.

The tree belt structure is the combination of arbors, frutex, and grassland, forming a tree belt that is running, close and the best degree of closing below 0.1.

In dry season, trees can be pertinently sprinkled with water. Dusts on tree leaves are washed, and the ability of blocking dust has recovered. Trees will not waver in the wind, causing secondary dust pollution.

With those measures mentioned above, dust pollution in the project will not cause the change of air function in the environment, and the requirement of the local environment protection in Baoshan District and Shanghai City will be met.
(2) Improvement of process engineering for cooling discharge

It is better to discharge warm water by means of offshore discharge. Warm water pipes are buried under the tidal zone, to avoid the impact of temperature rise on the ecologic community in the tidal zone with good diversity, and facilitate dilution, pervasion, and temperature drop of flush flow in the Yangtze River when warm water is discharged. Thus, the impact of warm water discharge on the ecosystem will be minimized.

(3) Enhancement of supervision management in warm water discharge

Warm water discharge should be closely restricted by means of intensive supervision, strict management, relevant law, regulation and standard. The temperature situations and the changes of the aquatic ecologic community in surrounding water areas have to be supervised regularly. And the measures for emergency have to be taken once the abnormal situations are discovered.
14 **Assessment of social environment effects**

Baoshan Iron & Steel Co. Ltd Group Pudong Iron & Steel Co. (therefore after refers to Pusteel) will move to Luojin town, Baoshan district. Its previous location will be used for the arena of World Expo 2010 Shanghai. The planned construction site is close to Luojin port in north, facing Road Beiyunchuanlu in the south, 400m away from the boundary of the new Chuanshahe in the west and reaching Road Shixianglu in the east, an area of 2.82 km². In the area are 21 production teams in the two towns, Luojin and Yuepu in Baoshan District. The problems of social environment effects remain to be at the time of pre-construction, construction and post-construction in Luojin and Yuepu of Baoshan Strict.

14.1 **Social environment effects before construction**

Social environment effects before construction present the requisition land for construction and moving of residents, enterprises, schools and other organizations in the area; and the social environment effects of allocating these peasants and working units.

14.1.1 General situation of requisition land, breaking – moving and allocation

(1) Area of requisition land

The total area of requisition land is 2.82 km², of which the collective is 3580 mou, including farmland and house sites. The current situations in the area of requisition land is peasant houses, land for enterprise, farmland and rivers, roads, etc.

Two features of the countryside in the area:

- Little area of average farmland, each and every family is not a pure farming family. The main family income is the salary from the enterprises in the towns (villages) or from the service industry. The contracted responsibility field in every family is contracted with the farmers from the other areas.

- The main part of the farmland in Yuepu Town is growing vegetables, and the main in Luojin is growing crops. The crop rotation of crops in a year is rice and wheat, that is growing rice during May and November, growing wheat during November and May in the coming year. Rice output per mou is 500kg or so, and wheat output is 300kg; The yearly output of vegetables is 2300 kg or so, its average
coefficient of multiple cropping is 3.5 or so.

(2) Number of breaking - moving

According to the elementary statistics in Pusteel project, 1345 houses have to break and move, the units that have to move is 40, occupying an area of 469030 m², and the area of the construction is 203800 m². The units concerned are production enterprises, shops, markets, breeding farm, storage houses, village committees, standard workshops and primary schools, see Table 14. 1 – 1, 14. 1 – 2, 14. 1 – 3.

The background of farming families plots in Pusteel project

<table>
<thead>
<tr>
<th>Plot ownership</th>
<th>Plot location</th>
<th>Number of production teams</th>
<th>Number of farming families</th>
<th>Number of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luojin Town</td>
<td>Within the planned red line</td>
<td>15</td>
<td>1200</td>
<td>3144</td>
</tr>
<tr>
<td></td>
<td>Conserving zone</td>
<td>4</td>
<td>86</td>
<td>377</td>
</tr>
<tr>
<td>Yuepu Town</td>
<td>Within the planned red line</td>
<td>2</td>
<td>55</td>
<td>162</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>21</td>
<td></td>
<td>3683</td>
</tr>
</tbody>
</table>

The background of enterprises plots in Pusteel project

<table>
<thead>
<tr>
<th>Plot ownership</th>
<th>Total enterprises</th>
<th>Enterprise location</th>
<th>Occupation (m²)</th>
<th>Construction (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Within house sites</td>
<td>Within conserving zone</td>
<td></td>
</tr>
<tr>
<td>Luojin Town</td>
<td>38</td>
<td>36</td>
<td>2</td>
<td>261,571</td>
</tr>
<tr>
<td>Yuepu Town</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>207,454</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>38</td>
<td>2</td>
<td>469,025</td>
</tr>
</tbody>
</table>
Table 14 1-3 Enterprises plots in Pusteel projet

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of enterprise</th>
<th>Construction (m²)</th>
<th>No.</th>
<th>Name of enterprise</th>
<th>Construction (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Haihong village committee</td>
<td>2100</td>
<td>2</td>
<td>Xiuhong bed clothing factory</td>
<td>4447</td>
</tr>
<tr>
<td>3</td>
<td>Sanzha mixing and stirring</td>
<td>1423</td>
<td>4</td>
<td>Fuchunya company</td>
<td>3600</td>
</tr>
<tr>
<td>5</td>
<td>Haihong farming storage house</td>
<td>1450</td>
<td>6</td>
<td>Prining house</td>
<td>2576</td>
</tr>
<tr>
<td>7</td>
<td>Haihong Baking Paint</td>
<td>445</td>
<td>8</td>
<td>Haihong integration</td>
<td>1093</td>
</tr>
<tr>
<td>9</td>
<td>Haihong accessory ingredient</td>
<td>4159</td>
<td>10</td>
<td>Lihong auto repair shop</td>
<td>1094</td>
</tr>
<tr>
<td>11</td>
<td>Liangxing development</td>
<td>15000</td>
<td>12</td>
<td>xintaishan</td>
<td>/</td>
</tr>
<tr>
<td>13</td>
<td>Haihong sideline shed</td>
<td>2500</td>
<td>14</td>
<td>Chuanshadonghua paper making factory</td>
<td>6400</td>
</tr>
<tr>
<td>15</td>
<td>Chuansha sideline</td>
<td>11995</td>
<td>16</td>
<td>Employee lodging house</td>
<td>2700</td>
</tr>
<tr>
<td>17</td>
<td>Shanghai fengmin electric appliance</td>
<td>1925</td>
<td>18</td>
<td>Chuansha plating</td>
<td>11163</td>
</tr>
<tr>
<td>19</td>
<td>Feeding lot</td>
<td>1940</td>
<td>20</td>
<td>Chuansha village committee</td>
<td>570</td>
</tr>
<tr>
<td>21</td>
<td>Chuansha integration shop</td>
<td>2000</td>
<td>22</td>
<td>Market lot</td>
<td>332</td>
</tr>
<tr>
<td>23</td>
<td>Non staple station</td>
<td>200</td>
<td>24</td>
<td>Chuansh water supply</td>
<td>240</td>
</tr>
<tr>
<td>25</td>
<td>Seed and cow farm</td>
<td>8500</td>
<td>26</td>
<td>Baofeng primary school</td>
<td>4000</td>
</tr>
<tr>
<td>27</td>
<td>Cotton purchasing</td>
<td>550</td>
<td>28</td>
<td>Chuansh drug store</td>
<td>100</td>
</tr>
<tr>
<td>29</td>
<td>Shanghai Xiehui electric appliance</td>
<td>2511</td>
<td>30</td>
<td>Chuansh Jinjia store house</td>
<td>710</td>
</tr>
<tr>
<td>31</td>
<td>Chuansha integration store house</td>
<td>1940</td>
<td>32</td>
<td>Haitang control house</td>
<td>1150</td>
</tr>
<tr>
<td>33</td>
<td>Haihong sideline shed</td>
<td>5600</td>
<td>34</td>
<td>Baofeng store house</td>
<td>250</td>
</tr>
<tr>
<td>35</td>
<td>Pailou store house</td>
<td>212</td>
<td>36</td>
<td>Rice processing plant</td>
<td>120</td>
</tr>
<tr>
<td>37</td>
<td>Haihong storage house</td>
<td>500</td>
<td>38</td>
<td>Chuansh family li store house</td>
<td>520</td>
</tr>
<tr>
<td>39</td>
<td>Standard workshop</td>
<td></td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(3) Allocation situation

Requisition land allocation
Farmers will lose their production means that they depend on because of requisition land. Even though, most of the farmers expect to leave their land for allocation, and enjoy a city life. According to the relevant policies of the government, three measures are taken to allocate requisition land farmers:

- Introduced by personal affairs department to work in an enterprise or a government office;
- One shot compensation is given to the requisition land farmers and let them start a new career;
- Pension will be offered to the women above 45, and man above 55.

Compensation cost for requisition land is offered every year.

(4) Allocation for farmers' house breaking and moving

According to the relevant laws, regulations and the requirement in Shanghai Overall Layout, the house breaking and moving has to be allocated properly with the cooperative efforts of the construction unit and the local town government and village committees. Farmers at the Pusteel construction site, will be arranged respectively to live in the new commercial housing in Lojin community and Shengqiao community.

(5) Allocation for enterprises

According to the relevant regulations, one shot economic compensation is offered to the enterprises that have to move. As to the allocation of the enterprises, the project developer will compensate for their fixed assets and part of the non-fixed assets of the enterprise that have to move. And the enterprises have to do their own rebuilding after moving.

According to the requirements of industries gathering in a park in Shanghai Overall Layout and the requirements of Shanghai Environment Protection Plan, some of the mid-sized, profitable town-village enterprises with little pollution, will move to industrial park in Baoshan; as to the enterprise and breeding farms with out of date process, severe pollution and in the wrong direction of Baoshan industrial development will have to disappear without allocation; with the help of the opportunity in Pusteel project, the current town-village enterprises can be changed in line with industry development.

14.1.1 Impact of requisition land and breaking – moving on social environment
(1) Shrink of farmland area

According to Baoshan yearly statistics, at the yearend of 2003, farmland area in Luojin Town is 1656.2 ha, farmland in Yuepu Town is 1011.2 ha. Of the total requisition land in Pusteel project, farmland area is 217 ha, counting for 12.25% of farmland area in Luojin Town. The average area shrink of individual farmland in the whole town is 91m²; Accounting for 1.4% of the farmland area in Yuepu Town, and the average area shrink of individual farmland is 12m².

According to the statistics, the total farming area in Luojin is 2061 ha, of which the foodstuff crops area is counting for 73% of the total; the total farming area in Yuepu is 1239 ha at the yearend of 2003, of which vegetable growing area is counting for 86.8% of the total area. Because of requisition land, the shrink of farmland will reduce both the vegetable supply to Shanghai City and the economic income of vegetable farmers. According to the estimation, the annual income of growing vegetables is 5000 yuan or so, growing vegetables is fairly profitable.

(2) Impact of farmers’ allocation

Luojin Town and Yuepu Town are located in developed Baoshan district. There are power plant, coal gas plant and all kinds of enterprises at the level of district, town and village. Except the old, most people are working in different enterprises; the income from farming is not the main source of their economic income. So, most farmers do not object to requisition land, and on the contrary, they expect to leave farmland and enjoy a city life.

People above 60 are delighted to get pension from the town government. In a general way, farmers’ income from pension is more than that from farming, and they are secured. As to the female of 45, retirement seems to be a little early. These people who have families to support are energetic, but less educated. They are less confident to start a new career without professional knowledge. Without sufficient pension to support families, they may have some economic and emotional difficulties in life, facing the changeable market economy and the high city cost of living.

Few of the people who are fairly well-educated or professional are qualified, or they are very particular about the economic income of the working units, the type of work, and it’s a tough job to allocate them. Most farmers who had their jobs in the local area are not satisfied with the jobs offered, and they prefer to have one shot compensation from requisition land.

Thus, farmers of different ages will be allocated in a different way and they are
free to make a disision. By and large, farmers who have to lose their farmland are fairly satisfied.

(3) Impact of farmers house breaking - moving

There will be some living environment change after the farmer house breaking – moving from the local residential area and environment, mainly the change of living conditions, traffic and living style, etc.

Farmers’ living environment and house conditions

Basically the families that have been impacted are farmers’ houses. These independent, two story-ed farmer houses with half timber construction were built in late 1970’s. They are large and simple – structured without hygiene and gas facilities, scattering nearby the villages and high way. It is very inconvenient for residents, for there is no school, shop, hospital, public traffic, and no modern life facilities. And there are quite a few good looking houses that have been built in the past years.

Impact of farmers house breaking - moving

After house breaking – moving, the farmers will be arranged by the town government to live in the allocation commercial houses in Luqin and Shengqiao. The farmers who planned to collect money to rebuild their houses, are greatly delighted to welcome requisition land, because their houses were built long ago.

But those farmers whose houses have been rebuilt in the recent years fail to gain the total compensation even with the allocation from the government, and they will have to suffer a great loss.

As to the farmers, collecting money and building a house is a life and death matter. Many farmers live a simple life and deposit money all their lives to build a house. Building a new house has exhausted their total savings, and they may have some sort of a special attachment to the new house on which they have spent their manpower, materials and energy. Thus, the breaking – moving of these farmhouses will have impacted on farmers greatly, improper dealing with the situation may lead to an unstable social factor.

Improvement of living conditions

Allocation houses will be built after farmhouse breaking – moving in line with Design code for residential buildings and Design criteria for residential buildings.
and the supporting facilities of water, gas and hygiene will be improved greatly. The community greening will be conducted in accordance with Rules on Greening of Environment for Shanghai Residential Areas, counting for 35% of the total, and the hygiene situations in the community better than that in the villages.

1 Impact on traffic

According to the allocation plan, the moving farmers will move the allocation base in Luojin and Shengqiao. The facilities in this allocation base where the moving farmers will gather will be not matched in a period of time. So, within a short period of time, it will be inconvenient for the residents on the allocation base to go out, go to school and to see a doctor. But compared to the current traffic situations of these farmers, it is more convenient. The families scatter in the current living area in the countryside, far from the main road, school. The allocation base will be in a town, and the large size residential base is close to the main road, and the public traffic, school and hospital are matched.

1 Life style change of allocation farmers

Turning to a city life from a country life, it is easier for young people to adapt to the life style change. But it will take rather a longer time for the old who have been used to the independent, farm yard life style to adapt to the cold, narrow life area. Thus, some of the old may feel lonely, and the rest of their lives may not be so happy.

The residential areas in Luojin and Shengqiao are the newly planned residential areas in Luojin Town and Yuepu Town. These areas will be matched with school, hospital, shop as well as cultural entertainment and public utilities when planned. Thus, in the newly built residential areas, are the new, spacious and bright houses with independent gas and hygiene facilities; and in front of houses and along the roads are grasslands, trees and flowers. The tidy and beautiful residential areas present a comfortable and peaceful living environment.

The problem in the newly built residential areas is that it is inconvenient for residents to go out for the bus line may not be extended or matched at the transition stage with less than 50% of the residents. It is also inconvenient for residents within a short time without supporting school, hospital, commercial network, but much more convenient than in the former farmhouses.

(4) Impact of working unit moving

1 Pollution of moving enterprises in operation
Of all 40 enterprises that have to move, some polluting enterprises will have to shut down and get out of use, including mainly Chuansha Plating, Breeding Farm and Cattle Farm. It is necessary for some moving enterprises to transport raw and accessory materials and products, mainly the paint of Haihong Baking Paint, Haihong Accessory Ingredient. Remains of chemical raw materials and products may present impact on the environment.

The plating bath and its polluting equipments with the stored chemicals have to be dismantled with strict plan, avoiding pollution caused by heavy metal, waste acid and alkali to the soil, underground water, preventing the pollution of chemical remains.

While moving breeding farm and cattle farm, the feces of poultry and livestock may pollute the surface water, the air and the environment hygiene. And so, while moving breeding farm and cattle, feces have to be cleaned thoroughly, transported to the professional disposal, not presenting pollution.

Impact on moving enterprises in operation

Three aspects of the adverse impact on the enterprise may be presented: (1) the enterprise may suffer an economic loss because of shutting down while dismantling and rebuilding; (2) a lot of capital and manpower have to be invested while reforming the enterprise and rebuilding the workshops; (3) the enterprise may lose its partners and new projects because of dismantling. It may not be a short period of time for the enterprise to suffer economic loss while shutting down and rebuilding, and it takes a long time to resume its production and marketing. However, there are some favorable situations available. The enterprise may take the advantage of this opportunity to change the line of production and adjust its uncompetitive products, or update the out of date process and equipments, to improve production environment and create a better situation for its existence and development.

Impact on employees in moving enterprise

The employees’ normal operation activities will be interfered while the workshop buildings are being dismantled at the early stage of project construction. These employees will have to face coming off duty and waiting for a job.

Of these employees some are waiting temporarily for a job, and they will resume their jobs when the buildings dismantling and rebuilding finished. The production value of the enterprise will have to be reduced, and the employees’ economic income may also be reduced temporarily, but it will not present a burden on their mind.
The impact on the other employees is that they have to face a more difficult situation: the enterprise may discharge some employees. And they have to endure the reality of coming off duty. As to these employees, they will have to find a new job. It’s difficult for them to support their families with their mean incomes. And being forced to leave their working environment, some of them may feel listless and present a factor of social instability.

The state has come to be aware of the reality of these employees. At the present, the governments at all levels take great efforts to recreate job opportunities, open all kinds of training schools, develop service industries with new posts. It is the government’s efforts and the change of the employees’ ideas that can help those people to get a new job.

(5) Impact of working unit moving

Baofeng Primary School in the area has to be closed, and will be rebuilt, and the fewer students in this school in the recent years will be arranged by town government to study in the other schools. The students will not be unable to go to school, but it will take them a longer time on the way, for the school is farther away from their homes. Their rest time will be reduced and their performance may not be good enough. In view of this, the town government will take some relevant measures in any situation to help the students, such as using a shuttle bus.

(6) Impact of water supply plant moving

Breaking up and moving of Chuansha Water Supply Plant is involved in the project. Chuansha Water Supply Plant is a water supply in a village, and the water source is the underground water from a deep well, and the service is mainly to Chuansha villagers. According to the requirement of Shanghai City government and the amount of water supply in Chuansha village, the problem can be solved: (1) the small size water supply plant in Chuansha has to be closed; (2) the exploitation of underground water has to stop; (3) the customers of water supply have changed, 73% of the villagers in Chuansha village will move to Luojin residential community. And the water supply for the rest of the villagers still in Chuansha can be managed uniformly. There will be no adverse impact on water supply because of breaking up of Chuansha Water Supply Plant. On the contrary, Pusteel’s relocation will facilitate the closing of a small size water supply plant, and the water quality of the farmers will also be improved.

(7) Impact of shop closing and moving

The shops involved in this project are Chuansha Integration Shop, Market Lot, Non Staple Station, Chuansh Drug Store, etc, and they are all in Chuansha village.
The customers of these shops are villagers in Chuansha, and 73% of the villagers in Chuansha village will move to Luojin Town residential community, and the 27% rest remain to stay where they are. There will be some inconvenience in the daily life of the villagers who remain to stay where they are, and their shopping is even more inconvenient because of shop closing and moving. The shop owners will be compensated economically for the shop closing, and they can choose a new area to re-open their shops based on the regional market demands.

(8) Impact of store house closing and moving

Seven buildings of storehouse involved in this project have to be pulled down, and they are Haihong Farming Storehouse, Chuansha Jinjia Storehouse, Chuansha Integration Storehouse, Baofeng Storehouse, Pailou Storehouse, Haihong Storehouse and Chuansha Lijia Storehouse, etc. Most of these storehouses have offered service to the enterprises: storing of their raw materials or products. The storehouse service has brought a lot of benefits to the economy in Chuansha village and Haihong village. Pulling down of these storehouses will reduce the village economic income and bring in some trouble storing raw materials and products for the enterprises renting a storehouse within a short period of time.

(9) Impact of greenhouse and facilities

Most of the greenhouses involved are the warm sheds in the countryside in Shanghai. To vegetable farmers, the price of vegetables planted in greenhouses is much higher than that of ordinary vegetables. Their planting schedule will be violated, their income reduced greatly because of greenhouse pulling down; to the grain farmers, the project construction will impact on grain planting while seeding in a greenhouse in the planting and seeding season, and their next year's grain ration will be reduced.

14.1.2 Comparison and analysis of living environment between pre-allocation and post-allocation

(1) Improvement of living conditions and environment of moving farmers

The living conditions and environment of some of the farmers who live in the simple houses in danger or in the old style farmhouses will change greatly after house breaking-up and moving. The living conditions of these farmers are fairly poor before house breaking-up and moving in the project, and without independent hygiene facilities and with little greening, the quality of the living environment is fairly poor. After house breaking-up and moving, these farmers' living area, house quality, house facilities and surroundings have improved greatly,
and they will have a peaceful, comfortable and spacious living environment. The change of farmers’ living quality before and after the project construction, see Table 14.1-4.

(2) The supporting facilities in the allocation area to be perfected

Allocation families in the project will be arranged to settle down in the town community with complete supporting facilities, such as commercial area, hospital, school, transportation. It is more complete and more convenient than in the countryside, and the basic desires of their living conditions will be satisfied. But the residential base is being built at the present, so are the supporting facilities. The situation calls for the efforts of the departments involved speeding up the pace of building the supporting facilities and the communities. So the settlers who will have moved to these residential areas can live and work peacefully and happily.

Table 14.1-4: The change of farmers’ living quality before and after the project construction

<table>
<thead>
<tr>
<th>Items of comparison</th>
<th>Before moving</th>
<th>After allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Living condition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House type</td>
<td>Two – story house</td>
<td>Multi or more story new house</td>
</tr>
<tr>
<td>House structure</td>
<td>Half timber construction</td>
<td>Reinforced concrete, brick</td>
</tr>
<tr>
<td>Gas and hygiene facilities</td>
<td>No</td>
<td>Complete and independent</td>
</tr>
<tr>
<td>House condition</td>
<td>Simple and spacious</td>
<td>Facing sun, spacious and ventilative</td>
</tr>
<tr>
<td>Outside environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grounded sections</td>
<td>countryside</td>
<td>urbanization</td>
</tr>
<tr>
<td>Land usage type</td>
<td>Farming land, road, residence</td>
<td>Residential area</td>
</tr>
<tr>
<td>Utilities</td>
<td>incomplete</td>
<td>Essentially complete</td>
</tr>
<tr>
<td>greening</td>
<td>No</td>
<td>35% area occupation</td>
</tr>
<tr>
<td>Environment quality</td>
<td>Noise, vibration</td>
<td>Clean, tidy, peaceful, comfortable</td>
</tr>
<tr>
<td><strong>Commerce, shopping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shop size</td>
<td>No essentially</td>
<td>Supermarket &amp; shops</td>
</tr>
<tr>
<td>Commodity variety</td>
<td>No essentially</td>
<td>Essentially complete</td>
</tr>
<tr>
<td>Number of shops</td>
<td>No essentially</td>
<td>some</td>
</tr>
<tr>
<td><strong>road traffic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>road path</td>
<td>path</td>
<td>Wide &amp; Straight</td>
</tr>
<tr>
<td>Public Traffic</td>
<td>Little &amp; Inconvenient</td>
<td>Much &amp; Straight</td>
</tr>
<tr>
<td><strong>Hospital</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Clinic or no</td>
<td>Town</td>
</tr>
</tbody>
</table>
It can be seen that the living conditions of farmers in the newly built residential communities in Luojin Town and Shengqiao Town have changed essentially, but the critical change is the change from country life to city life. On the whole they think the houses they live in are spacious and comfortable, though the problem of the total reduced living area stands out, since they need no space for storing farm tools, chemical fertilizer, firewood, serving they need for farming. Farmers are delighted to live in a town moving away from the scattering villages; their living environment has improved with little money and the support of the government.

14.1.3 Amount of solid building waste in breaking-up and moving

Judging by the field exploration, it is estimated that about 106000m² industrial buildings and 269000m² farmers’ buildings inside an area of 2.82km² will have to be dismantled in Pusteel project. The structure of the buildings is multi-story-ed half timber, the wall 15cm thick, 20m² area of every room, 2.7m high. Base on some data, there will be 0.7m³ building waste in dismantling 1m² area of house building. The building structure of enterprise buildings is reinforced concrete. There will be 0.8m³ building waste in dismantling 1m² area of enterprise building, for the wall of the buildings is fairly thick, the single room high. It is estimated that there will be 273100m³ at the early stage of dismantling in Luojin area in the Pusteel project.

Slag and building waste can be used as roadbed laying. The useless of the waste can not be dumped into rivers or mixed with residents’ domestic garbage. It has to be done by a construction company and the department in charge of environment and hygiene according to Administrative Provisions for Discharge Building Waste and Engineering Slag in Shanghai and Decisions on Dividing the Work of Discharging Building Waste and Engineering Slag in Shanghai (trial).

14.2 Analysis of environment impact in construction

Waste water, fume, dust, noise and muck will be brought in construction. They will present an adverse impact on water, air and acoustic environment, and also some impact on social environment. The factors that will impact on the environment are the following:

(1) Muck in construction
(2) Dust caused in construction

(3) Fume vented by construction machines and transportation vehicles

(4) Flushing waste water of construction machines

(5) Waster water in constructors' life

(6) Slime water and building waste in construction

(7) Noise and vibration of construction machines

(8) Impact of building material transportation on traffic

Though the impact in construction is partial and temporary, and will disappear at the end of construction, the civilization in construction presents the extent of a city's culture, material civilization and modernization.

14.2.1 Analysis of environment impact on air in construction

(1) Features of air pollution

Judging by the construction quality and the features of the environment, there are mainly these factors that are impacting on the air in the surroundings:

Building materials' dumping, piling, transportation, cement's stirring and placing.

Pollution of waste gas exhaled from the construction machines burning diesel oil and the end gas from large vehicles of building materials.

The main polluting factors during the construction are dust and end gas. At the different stages of construction, there are many situations in which dust will occur. That is there are many sources of dust, and dust emission of most sources last long, such as dust emission of cleaning and transporting, dust emission of piling building materials and road dust emission of construction vehicles coming and going to the sites at every stage of construction.

(2) Impact analysis of waste gas emission pollution

The builders' rubbish that has not been cleaned and carried away, earth digging, building materials' piling, loading and unloading and building materials' piling in the open air are the main factors that increase the suspended substance in the air of the construction environment. Piles of rare earth are spreading dust into the air.
when it is windy, and the flying particles of dust are covering the building and surrounding roads and people coming and going with a layer of dust and earth, and the concentration of particles exceeds the limit of the state standard, and the quality of people's living environment is deteriorating. Vehicles passing the dusty areas or trucks loaded with building materials entering the construction sites will raise a lot of dust while running. Some data have reported that a 14 ton heavy truck on the 30% dust road will raise 2.85kg dust within 1km distance at the speed of 20km/h. The construction sites are extremely muddy because of rain sweeping and trucks rolling. Large quantity of mud will stick to the wheels of the trucks coming and going on the road of this kind, bringing a lot of mud and dust onto the city roads. A vicious circle is going round and round. Dust is covering the whole city and the sky is no longer blue.

The transporting building materials is also one of sources to bring dust pollution. Firstly, overloaded transportation of sand, cement, stones and spoil; secondly, transportation of rare materials, dropping from the running trucks all the way, roads and environment untidy, constant dropping of building materials and spoil following a truck all the way if not windy, and dusty where it is if windy. The pollution of particles from a construction site will be spreading to a very large area. Thus, the spoil and the piling, transporting building materials will present a great change of concentration of particles in the air of the city. This is the problem of air quality people know quite well in their life.

Some data have reported that dust emission is main source of air pollution from a construction site, counting for 62% of dust emission in the whole construction site, about 38% in the other sites.

Air pollution of dust emission in a construction is spreading within the distance of 150m. The extent of pollution is different because of different distances. The area within distances of 0-50m is severely polluted, within distances of 50-100m fairly polluted, further 100m away slightly polluted, and still further 200m away not polluted essentially.

By investigation of comparison, the average concentration of TSP in the area of dust emission in construction is about 0.49mg/Nm3 under the normal weather conditions.

Dust emission caused by spoil is one of dust emissions, presenting greater effects at the loading and unloading sites, especially at the unloading site, but the effect is very slight at the unloading site because it is far away from residential area.

The construction machines and large vehicles carrying building materials are
diesel-powered. The end gas of burning diesel is full of particles and hydrocarbon, presenting pollution.

(3) Towns impacted

The pollution at the point of dust emission at the construction site may spread 150m away by analysis. And by estimation, the villages impacted 150m away from both sides of the red line in Pusteel construction are Haixing village, Haihong village, Hailu village that will not move as well as Chenhang reservoir.

14.2.2 Analysis of noise effects during construction

(1) Features of noise pollution and analysis of effects

Noise is made mainly during the construction stage such as dock construction, land leveling, base digging and building construction, etc. Dock construction is conducted by construction craft and construction machines; the source of noise in land leveling is bulldozer, fork-life truck, heavy truck and the source of noise in building construction is transportation vehicles, concrete mixer and air compressor in operation. Above 70dB(A) noise pollution of these machines can reach the area within the distances of 10-100m, see Table 14. 1-5. The problem of noise pollution in operation at night is remarkable and it can not be ignored. Furthermore, the noise caused by traffic jam is increasing in civil-work construction. So noise pollution in construction is the vital factor of environment pollution.

Table 14.2-1 Construction machines and different polluting radiuses of noise limits

<table>
<thead>
<tr>
<th>序号</th>
<th>机种</th>
<th>噪声限值dB(A)</th>
<th>阀值</th>
<th>噪声限值dB(A)</th>
<th>噪声限值dB(A)</th>
<th>噪声限值dB(A)</th>
<th>噪声限值dB(A)</th>
<th>噪声限值dB(A)</th>
<th>噪声限值dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tip lorry</td>
<td>106</td>
<td>84</td>
<td>78</td>
<td>72</td>
<td>64</td>
<td>63</td>
<td>60</td>
<td>58</td>
</tr>
<tr>
<td>2</td>
<td>Loader</td>
<td>106</td>
<td>84</td>
<td>78</td>
<td>72</td>
<td>66</td>
<td>63</td>
<td>60</td>
<td>58</td>
</tr>
<tr>
<td>3</td>
<td>Bulldozer</td>
<td>116</td>
<td>94</td>
<td>88</td>
<td>82</td>
<td>76</td>
<td>73</td>
<td>70</td>
<td>68</td>
</tr>
<tr>
<td>4</td>
<td>Digger</td>
<td>108</td>
<td>86</td>
<td>80</td>
<td>74</td>
<td>68</td>
<td>65</td>
<td>62</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>Fluid-pressure crane</td>
<td>102</td>
<td>80</td>
<td>74</td>
<td>68</td>
<td>64</td>
<td>59</td>
<td>56</td>
<td>54</td>
</tr>
<tr>
<td>6</td>
<td>Hoist</td>
<td>103</td>
<td>81</td>
<td>75</td>
<td>69</td>
<td>63</td>
<td>60</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>7</td>
<td>Grader</td>
<td>106</td>
<td>84</td>
<td>78</td>
<td>72</td>
<td>66</td>
<td>63</td>
<td>60</td>
<td>56</td>
</tr>
<tr>
<td>8</td>
<td>Traveling compressor</td>
<td>109</td>
<td>87</td>
<td>81</td>
<td>75</td>
<td>69</td>
<td>66</td>
<td>64</td>
<td>61</td>
</tr>
<tr>
<td>9</td>
<td>Truck crane</td>
<td>103</td>
<td>81</td>
<td>75</td>
<td>69</td>
<td>63</td>
<td>60</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>Pillar crane</td>
<td>109</td>
<td>87</td>
<td>81</td>
<td>75</td>
<td>69</td>
<td>66</td>
<td>63</td>
<td>61</td>
</tr>
<tr>
<td>11</td>
<td>Cement mixer</td>
<td>110</td>
<td>88</td>
<td>82</td>
<td>76</td>
<td>70</td>
<td>67</td>
<td>64</td>
<td>62</td>
</tr>
</tbody>
</table>

Except the average A of bulldozer noise in operation at night 40m away, the average A of all the other machines can answer for The standard of noise limits of construction site (GB12523-90) 150m away at night.

It can be seen that there is noise pollution at some sites close to residential areas in the construction, and with protection methods for acoustic environment, the tension of acoustic environment can be relieved.

(2) Towns impacted

By analysis, the villages that will be polluted are Haixing village, Haihong village, Hailu village that will not move, for noise pollution at a construction site can be 150m away.

14.2.3 Analysis of waste water pollution in construction

(1) Features of waste water discharge in land area

The waste water in construction is: waste water of employees’ daily life full of SS and CODcr; waste water of slime water in construction full of SS; builders’ rubbish and spoil in the open air full of SS, swept by rainwater in rainy season; waste water of washing machines full of SS and oils.

(2) Analysis of waste water pollution in land area

The waste water pollution during the project construction is the running water of building materials piling in the open air and the waste water of workers’ life. The direct discharge of waste water will present severe pollution of surface water in the local area.

All kinds of oil pollutants dripping from construction machines and vehicles run onto the surface area of construction after raining, and they may also present some environment pollution without care. In addition, because of waste water in construction full of sand, and frequent rainstorms in a long rainy season in Shanghai, there will be some water and soil loss while digging, transporting, backfilling and unloading, presenting some pollution to surface water body in surrounding environment, and the situation can not be ignored.

The discharged water in construction is mainly the slime water full of pieces of cement, stones, and sand, and the current of rainwater running on the ground.
The slime water in operation and the rainwater at a construction site will present some pollution to the environment, if they are discharged casually. The slime water will present some pollution to the surface water and increase suspended matter and the concentration of CODcr if they are discharged into rivers.

The waste water in daily life is mainly the waste water from workers’ temporary dining room and lavatory. The waste water in a dining room is full of animal and vegetable oils and some organic pollutants, and the waste water in a lavatory is full of ammonia nitrogen as well as a lot of organic pollutants and bacteria. The waste water will bring pollution to the received water body and a lot environment problems if discharged casually without treatment.

14.2.4 Muck disposal and management during the construction

(1) Discharge characteristics of muck

The muck in construction of Pusteel project is mainly the piles of muck with little domestic garbage. Spoil is the most of muck, then the pieces of brick, fragmentary reinforcing bar concrete, useless wood, useless steel bar and the unwanted cement concrete. These piles of muck occupy a large area if inside the construction area and prevent operation, and they are also the source of dust emission and water body pollution; piles of muck, if in a public area, will not only destroy the beauty of the city but also block the traffic. And they have to be treated properly.

(2) Management of muck discharge

There will be a lot of builders’ rubbish and spoil in construction. Enhancement of spoil management is significant in construction civilization. Based on Article 7 of No 23 Decree issued by the government of Shanghai City on May 15, 2004 (Responsibility of Engineering, Greening and House Breaking-up for Preventing Dust Pollution), the cost of engineering, greening and house breaking has to be included in project estimate, and the responsibility has to be shared by the construction company in a contract.

Article 8 (Requirements for Dust Emission Prevention in Engineering Construction): In a central city, new town, central town, tourist area (site), large traffic hub for passengers, dust emission prevention in construction has to be conducted in line with the following.

(1) The construction site, where dust pollutants that are easily produced by cement, gray soil, sand and stones are piled, has to be separated by a closing fence not lower than the height of the pile; scaffolds have to be closed by dense safety net
outside.

(2) The construction company has to level the construction site and remove the piles within 30 days after the completion of the project.

(3) The air compressor can not be used to clean dirt and dust on vehicle, equipment and material.

(4) The floor at the construction site has to be hardened.

(5) In the event there is lot of mud produced during the construction operation, the mud pit and mud trench have to be available to prevent the mud from overflowing, and the waste mud shall be transported outside by sealed tank truck.

(6) In a central town, the cement mixer with a daily amount of 30m3 is not allowed to be in operation in the open air; the mixer with a daily amount below 30m3 will have to be operated, if necessary, in the open air, and measures for dust emission must be taken.

(7) The construction company should use premixed mortar.

**Article 9**  (Requirements on dust prevention for house building): In addition to the requirements as stipulated in Article 8, the following regulations shall be followed during the construction in central city, new town, central town, tourist area (site) and large traffic hub:

(1) The solid fence not below than 2m has to be set up around the construction site.

(2) Inside the construction area, the vehicle cleaning equipment, drainage and mud deposition facilities shall be supplied; and the vehicle will not be able to drive out of the construction site without cleaning.

(3) The builders rubbish and the construction muck that can not be cleaned up will pile up. A temporary piling site will be set up inside the construction site with fencing and covering measures.

(4) While transporting bulk materials, builders rubbish and muck high over the buildings and structures, they should be carried away in a sealed manner. Throwing and scattering high in the air is prohibited.

(5) The construction company should do some greening or paving at the nudity of the construction site that has remained unused for above 6 months.
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

Article 11 (Requirements on dust prevention during tearing down house): House tearing down in a central city, new town, central town and tourist area (site) should be conducted in line with the following:

(1) When the wind speed is class 5, house blowing up or house tearing down has to be prohibited.

(2) Before house tearing down or blowing up, the house should be watered or sprinkled; when people are tearing a house, the house can not be watered or sprinkled if the watered or sprinkled house threatens people’s safety.

(3) Inside the construction area, the vehicle cleaning equipment, drainage and mud deposition facilities shall be supplied; and the vehicle will not be able to drive out of the construction site without cleaning.

(4) The builders’ rubbish that can not be cleaned up within 48 hours should be covered and watered to prevent dust emission.

Article 12 (Management of Dust Emission Pollution Prevention and Treatment at Construction Site): The construction company undertaking house tearing building and house tearing down should report its scheme for dust emission pollution prevention and treatment to the departments of administration in the local district and county 3 workdays before the construction and open strikingly its scheme to the public around the construction site. And the scheme has to be well kept until the end of the construction.

Article 13 (Requirements for Dust Emission Prevention in Transporting Materials): A company or an individual undertaking transporting materials that are source of pollution in a central city, new town, central town and tourist area (site) should use a sealed tank truck. If the company is unable to undertake the transportation in a sealed way, the transportation has to be consigned to a company or an individual that is capable of doing so.

The transportation company and an individual should be responsible for the maintenance of the sealed device to be sure of its performance. The materials in transportation can not leak, drop or spread all the way.

If the vehicle that undertakes builders rubbish and muck does not accord with the requirements for the sealed transportation, it will not be given the permit for undertaking builders’ rubbish and construction muck.

14.2.5 Impact on the infrastructure in the area
According to the development and the plan of the project, a man-made canal around the company has to be dug in the construction, and farmhouses, enterprises and the land have to be rearranged. In digging the canal, underground water pipes, cable lines may have been affected, and the construction company should contact in advance the departments involved, get to know the locations of the pipes and lines, sometimes change or remove the pipes or lines to avoid the damage of them, and to make sure that the residents' life and enterprises' operation are regular.

14.2.6 Impact on residents

The environment quality of the construction site and the local area will be lower because of the waste water, waste gas, noise and muck in the construction. Meanwhile, the sights in the area are likely to change because the trees and greening have been moved or occupied. The traffic will be more inconvenient and the living environment of the residents has been impacted. The residents in the surroundings will have to endure the disturbance from the construction, because the construction period is long in Pusteel project, and they may feel restless and listless and may have some psychological problems. Therefore the living quality of the surrounding residents will be impacted to some extent.

14.2.7 Impact on the traffic in the area

The traffic will be busier on Road Beiyunchuanlu, for the heavy trucks carrying building materials and earth enter the construction site via Beiyunchanlu during the construction. The situation will present some impact on the traffic, the local enterprises' transportation, the residents' activities and children's schooling. The construction company will have an operation schedule to avoid the rush-hour in the morning and in the afternoon, relieve the tension of traffic jam in some area.

14.2.8 Impact on cultural relics and historic site

Based on the investigation of the cultural relics and historic sites in the area, there are no buildings with cultural relics and no rare old trees in the construction area. So there is no impact on cultural relics, historic sites and the cultural heritage.

14.3 Analysis of the impact on social environment in operation

Shanghai Pusteel company, a 90 year-old factory, will move away from Zhoujiadu area on Huangpu river band in Pudong to Luojin area in Baoshan District for the sake of World Expo.2010 Shanghai China. The relocation of Pusteel will play a significant role in promoting Shanghai's overall economic development and the development strategy of iron & steel industry, and its social benefit will be
presented in the following:

14.3.1 Favoring Shanghai’s image in the world

Shanghai is essential in the development of Chinese economy, and its development implies the overall development of the whole country. Moving Pusteel away from Pudong’s central area means a great contribution to the environment quality of World Expo. 2010 Shanghai. It will help to improve the environment quality in central area of Shanghai, to favor Shanghai’s international image, to show the world China’s image and develop Shanghai in a better way, to increase Shanghai’s service to the whole nation and to promote Shanghai’s economy as well as the economy in the Yangtze Delta.

14.3.2 Speed up the overall development on both sides of Huangpu river

The overall development on both sides of Huangpu River will be characterized by four areas: fashion residential area, shopping & sightseeing area, unique residential area and culture & tourism area. The arena of World Expo. is close to the south end of the planned development area on both sides of Huangpu River, in line with the area’s functional location, and the area’s development will speed up.

14.3.3 Facilitating the city’s overall development and industry play-out

Pusteel is located nearby Huangpu River band, close to the downtown area of the city. With the speeded up pace of development and opening to the outside world, people are in need of a better life and a better environment. Pusteel’s operation in Zhoujiadu area is restrained by many factors. The transportation, as well as cityscape and environment protection, will make it difficult and improper for Pusteel to be in operation in the current area. According to the overall plan and industrial lay out in Shanghai, iron & steel industry will gather in Baoshan District. Therefore, it is significant to move Pusteel away to Baoshan and to rearrange Shanghai’s land usage and the lay out by taking the advantage of choosing a location for the arena of World Expo. in Pudong.

14.3.4 Speeding up realizing the strategic goals in Shanghai’s iron & steel industry

Pusteel’s relocation will perfect the best choice strategy of Baoshan Iron & Steel Co., Group. Pusteel’s relocation will break up the organization and manufacture of Baosteel, facilitate the overall development plan in Shanghai’s iron & steel industry, so that different iron & steel manufacturers will be able to take advantage of their strengths, and help make Baosteel the base of special strip steel and sheet steel, and different manufacturers will be comprehensively competitive in
cutting cost and increasing profit.

New technology and new process will be adopted in producing sponge iron and sheet slab after Pusteel's relocation, the best quality raw materials that Baosteel lacks for manufacturing best quality products will be supplied to the group and Baosteel will be more competitive with best quality products, and Baosteel's resources will be utilized to the maximum extent.

14.3.5 Facilitating the sustainable development of the group

Pollutant discharge amount in Zhoujiadu will decrease greatly after Pusteel's moving away from the area, and the environment quality in the area will improve remarkably, and the adverse effect in the area of Huangpu River and the surroundings will disappear, so the environment quality in the central area of Shanghai will improve significantly. Significant social benefit

After Pusteel's relocation in Lujin, the out-of-date process fall into disuse and the advanced technology in the frontier of world iron & steel industry will be imported to help utilize the resources, consume energy and operate in a clean environment at the world level. The advanced technology in iron melting, steelmaking and rolling will be adopted in one economic body, the pollutant discharge can be controlled essentially, and the sustainable development of the enterprise will be facilitated.

14.4 Measures for adverse social effects

It can be found that on the whole, Pusteel's relocation in Lujin away from Zhoujiadu will not only bring good social benefits but also present some adverse effects before and during the construction. So the construction company has taken some measures for the effects, such as allocation, but it will have to take some further measures to reduce the adverse effects, see Table 14. 4-1.

Table 14. 4-1 A list of measures for relieving social environment effects

<table>
<thead>
<tr>
<th>Received body</th>
<th>Adverse effects</th>
<th>Relieving measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmhouses</td>
<td>Tearing down and moving</td>
<td>Compensation Allocation</td>
</tr>
<tr>
<td>Enterprise houses</td>
<td>Output reduction, production stop</td>
<td>Compensation Allocation</td>
</tr>
<tr>
<td>Farmland</td>
<td>Agriculture income reduction</td>
<td>1. proper allocation of manpower Timely pension offer and town security</td>
</tr>
<tr>
<td>Rivers</td>
<td>Overflow</td>
<td>1. bed-load setting tank Diversion or pump drain</td>
</tr>
</tbody>
</table>
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th>Public service facilities, pipes and lines</th>
<th>Interfering with water supply, power supply and communication</th>
<th>Report in advance to the departments involved and get ready for moving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture and education facilities</td>
<td>Extension of distance on the way to school</td>
<td>Bus run about</td>
</tr>
<tr>
<td>traffic</td>
<td>Traffic jam</td>
<td>Operation time of transportation vehicle limited</td>
</tr>
<tr>
<td>Historic sites</td>
<td></td>
<td>Stop and report at once if discovered</td>
</tr>
</tbody>
</table>

14.5 **Brief summary**

The implement of Pusteel's relocation guarantees the opening of World Expo. Shanghai 2010 in the area and it will play an active role in showing the world the image of China and the image of Shanghai. Pusteel's relocation will promote industrial restructuring in Shanghai, drive the economic development in Shanghai and the Yangtze delta, and elevate Shanghai's comprehensive competitiveness.

On the whole, Pusteel's relocation will bring good social benefits, however it will certainly present some adverse effects at the early stage of the project and during the construction. At the early stage of the project construction, some farmland will be requisitioned and quite a lot of farmhouses and enterprises' buildings will have to be dismantled. The situation will present some adverse social environment effects if the measures for a relief are taken improperly. So the construction company will have to attach importance to the relieving measures to avoid some social instability.
15 **Technical and economic appraisal of environment protection measures**

15.1 **Technical appraisal of environment protection measures**

15.1.1 Analysis of pollution source

15.1.1.1 Analysis of pollution prevention measures

Analysis results of pollution control measures for air pollution source in Pusteel relocation, see Table 15. 1-1, Table 15.1-2.

The results of Table 15. 1-1, Table 15.1-2 indicate: the effluent concentration and speed of all air pollution source discharges and the effluent concentration and speed of SO2, NOX, F come up to the secondary standards of (Emission Standard of Air Pollutants for Industrial Kiln and Furnace) and (Integrated Emission Standard of Air Pollutants), they are all discharges that come up to the standard.

According to the analysis of the quality of the waste water, the analysis results of the waste water pollution source in the project are in Table 15. 1-3.

Table 15.1-3 Analysis results of the waste water pollution source in Pusteel relocation

<table>
<thead>
<tr>
<th>Item</th>
<th>SS</th>
<th>CODcr</th>
<th>Petroleum oil</th>
<th>Cr6+</th>
<th>T-Cr</th>
<th>T-Ni</th>
<th>Fluoride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge concentration (mg/L)</td>
<td>70</td>
<td>80</td>
<td>5</td>
<td>0.03</td>
<td>1.0</td>
<td>0.04</td>
<td>1.0</td>
</tr>
<tr>
<td>Discharge standard (mg/L) (DB31/199-1997) Class 1 standard</td>
<td>≤70</td>
<td>≤100</td>
<td>≤5</td>
<td>0.5</td>
<td>≤1.5</td>
<td>≤1.0</td>
<td>≤10</td>
</tr>
<tr>
<td>Analysis results of coming up to the standard</td>
<td>Up to the standard</td>
<td>Up to the standard</td>
<td>Up to the standard</td>
<td>Up to the standard</td>
<td>Up to the standard</td>
<td>Up to the standard</td>
<td></td>
</tr>
</tbody>
</table>

The analysis results in Table 15. 1-3 indicate: the quality of waste water discharged in Pusteel relocation is in line with the class 1 standard of (Standard for Comprehensive Wastewater Discharge in Shanghai DB31/199-1997), all are the discharges that come up to the standard.
The comprehensive analysis indicates: pollution control measures for pollution sources in Pusteel relocation are effective, all pollution sources discharges can come up to the standards.

15.1.1.2 Feasibility analysis about "up to the standard"

According to the analysis of the current pollution control in metallurgical industry in China, the bag filter system of fume and dust pollution source is adopting overlay film filtering materials, the pollution control can be below 35mg/Nm3; the fuel for Rolling mill heating furnace is coal gas from iron melting, containing H2S 70 – 100ppm, the concentration of SO2 can be kept below 100mg/Nm3 (The limit is 550mg/Nm3); in the heating system of industrial coal gas fuel, the concentration of NOx can be kept below 240ma/Nm3 under the normal condition, and the concentration of NOx is even lower because of adopting the low nitrogen burner in Rolling mill heating furnace. So the discharge concentration of NOx in all heating systems can be kept below 240mg/Nm3.
Table 15. 1-1 Analysis of up to the standard of organized air pollution source (dust) discharge (including stage 1, stage 2)

<table>
<thead>
<tr>
<th>Item</th>
<th>Major pollution sources</th>
<th>Measures for pollution prevention</th>
<th>Max. discharge concentration (mg/Nm3)</th>
<th>Max. discharge speed (kg/h)</th>
<th>Discharge pipe height</th>
<th>Control standard</th>
<th>Analysis of up to standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Stock yard</td>
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<td></td>
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<tr>
<td>1</td>
<td>Feeding convey 1#</td>
<td>Sprinkling dust laying &amp; Bag filter</td>
<td>35</td>
<td>19.1</td>
<td>30</td>
<td>120</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>Feeding convey 2#</td>
<td>Sprinkling dust laying &amp; Bag filter</td>
<td>35</td>
<td>19.1</td>
<td>30</td>
<td>120</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>Corex iron melting</td>
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<td></td>
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<td></td>
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<tr>
<td>3</td>
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<td>Bag filter</td>
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<td>1.3</td>
<td>25</td>
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<td>4</td>
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<td>1.3</td>
<td>25</td>
<td>120</td>
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<td>1.6</td>
<td>25</td>
<td>120</td>
<td>14.5</td>
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<tr>
<td>Item</td>
<td>Major pollution sources</td>
<td>Measures for pollution prevention</td>
<td>Max. discharge concentration (mg/Nm3)</td>
<td>Max. discharge speed (kg/h)</td>
<td>Discharge pipe height</td>
<td>Control standard</td>
<td>Analysis of up to standard</td>
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<td>25</td>
<td>120</td>
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<tr>
<td>9</td>
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<td>25</td>
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<td>2.2</td>
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<tr>
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<td>Top charging 2#</td>
<td>Bag filter</td>
<td>35</td>
<td>1.0</td>
<td>25</td>
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<td>17</td>
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<td>4.4</td>
<td>25</td>
<td>120</td>
<td>14.5</td>
</tr>
</tbody>
</table>
### Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th>Item</th>
<th>Major pollution sources</th>
<th>Measures for pollution prevention</th>
<th>Max. discharge concentration (mg/Nm³)</th>
<th>Max. discharge speed (kg/h)</th>
<th>Discharge pipe height</th>
<th>Control standard</th>
<th>Analysis of up to standard</th>
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</thead>
<tbody>
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<td>18</td>
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<td>35</td>
<td>100</td>
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<td>Bag filter</td>
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<td>35</td>
<td>35</td>
<td>100</td>
<td>—</td>
</tr>
<tr>
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<td>Storage bin &amp; feeding</td>
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<td>25</td>
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<td>1.3</td>
<td>25</td>
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<td>14.5</td>
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<td>25</td>
<td>120</td>
<td>14.5</td>
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<td>Desulphurization of molten iron</td>
<td>Bag filter</td>
<td>35</td>
<td>22</td>
<td>30</td>
<td>120</td>
<td>23</td>
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<tr>
<td>25</td>
<td>Converter 1#</td>
<td>OG system wet dust collector</td>
<td>100</td>
<td>4.6</td>
<td>80</td>
<td>100</td>
<td>—</td>
</tr>
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<td>Item</td>
<td>Major pollution sources</td>
<td>Measures for pollution prevention</td>
<td>Max. discharge concentration (mg/Nm³)</td>
<td>Max. discharge speed (kg/h)</td>
<td>Discharge pipe height</td>
<td>Control standard</td>
<td>Analysis of up to standard</td>
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<tr>
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<td>35</td>
<td>30</td>
<td>100</td>
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<td>35</td>
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<td>100</td>
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<td>1.5</td>
<td>30</td>
<td>100</td>
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<td>Electric furnace steelmaking continuous cast pouring box dust collector</td>
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<td>Molten iron pouring</td>
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<td>21.9</td>
<td>30</td>
<td>100</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>36</td>
<td>Underground storehouse of raw materials and supplementary materials</td>
<td>Bag filter</td>
<td>35</td>
<td>3.8</td>
<td>25</td>
<td>120</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>Item</td>
<td>Major pollution sources</td>
<td>Measures for pollution prevention</td>
<td>Max. discharge concentration (mg/Nm³)</td>
<td>Max. discharge speed (kg/h)</td>
<td>Discharge pipe height</td>
<td>Control standard</td>
<td>Analysis of up to standard</td>
</tr>
<tr>
<td>------</td>
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<td>-----------------------------</td>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>38</td>
<td>Underground storehouse of iron alloy</td>
<td>Bag filter</td>
<td>35</td>
<td>3.8</td>
<td>25</td>
<td>120</td>
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<td>5. Rolling mill system</td>
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<td>Heavy plate shot blast dust collector</td>
<td>Bag filter</td>
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<td>25</td>
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<td>Vertical shaft kiln fume</td>
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<td>4.8</td>
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<td>Raw material warehousing and sizing,</td>
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<td>35</td>
<td>4.4</td>
<td>25</td>
<td>120</td>
<td>14.5</td>
</tr>
</tbody>
</table>

Note: 1. Pollution sources are carried out respectively by (Integrated Emission Standard of Air Pollutants) (GB 16297-96) and the secondary standard of (Emission Standard of Air Pollutants for Industrial Kiln and Furnace) (GB 9078-96)
Table 15. 1-2: Analysis of up to the standard of organized air pollution source (SO2, NOx) discharge (including stage 1, stage 2)

<table>
<thead>
<tr>
<th>Item</th>
<th>Major pollution sources</th>
<th>Measures for pollution control</th>
<th>Fume discharge (Nm³/h)</th>
<th>SO2 discharge speed (kg/h)</th>
<th>SO2 discharge concentration (mg/Nm³)</th>
<th>NOx discharge speed (kg/h)</th>
<th>NOx discharge concentration (mg/Nm³)</th>
<th>Discharge pipe height</th>
<th>Control standard</th>
<th>Analysis of up to standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Iron melting</td>
<td>Corex coal drier 1#</td>
<td>Emission by high chimney</td>
<td>150000</td>
<td>7.5</td>
<td>50.0</td>
<td>22.5</td>
<td>150</td>
<td>25</td>
<td>850</td>
</tr>
<tr>
<td>2</td>
<td>2. Rolling mill</td>
<td>Corex coal drier 2#</td>
<td>Emission by high chimney</td>
<td>150000</td>
<td>7.5</td>
<td>50.0</td>
<td>22.5</td>
<td>150</td>
<td>25</td>
<td>850</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Reducing gas heater</td>
<td>Emission by high chimney</td>
<td>55000</td>
<td>5.5</td>
<td>100</td>
<td>11.0</td>
<td>200</td>
<td>30</td>
<td>850</td>
</tr>
<tr>
<td>4</td>
<td>2. Pusher type reheating furnace</td>
<td>Emission by high chimney</td>
<td>54530</td>
<td>5.2</td>
<td>95</td>
<td>13.1</td>
<td>240</td>
<td>60</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>Item</td>
<td>Major pollution sources</td>
<td>Measures for pollution control</td>
<td>Fume discharge (Nm³/h)</td>
<td>SO₂ discharge speed (kg/h)</td>
<td>SO₂ discharge concentration (mg/Nm³)</td>
<td>NOₓ discharge speed (kg/h)</td>
<td>NOₓ discharge concentration (mg/Nm³)</td>
<td>Discharge pipe height</td>
<td>Control standard SO₂ discharge concentration (mg/Nm³)</td>
<td>Control standard NOₓ discharge concentration (mg/Nm³)</td>
</tr>
<tr>
<td>------</td>
<td>------------------------</td>
<td>--------------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>----------------------------------</td>
<td>------------------------</td>
<td>----------------------------------</td>
<td>-------------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Walking beam furnace</td>
<td>Emission by high chimney</td>
<td>160000</td>
<td>15.2</td>
<td>95</td>
<td>38.4</td>
<td>240</td>
<td>70</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Outer heating furnace</td>
<td>Emission by high chimney</td>
<td>62000</td>
<td>5.0</td>
<td>80</td>
<td>14.9</td>
<td>240</td>
<td>30</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Car bottom batch type furnace1#</td>
<td>Emission by high chimney</td>
<td>31000</td>
<td>2.5</td>
<td>80</td>
<td>3.1</td>
<td>240</td>
<td>30</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Car bottom batch type furnace 2#</td>
<td>Emission by high chimney</td>
<td>31000</td>
<td>2.5</td>
<td>80</td>
<td>3.1</td>
<td>240</td>
<td>30</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>1# roller hearth furnace</td>
<td>Emission by high chimney</td>
<td>39800</td>
<td>0.3</td>
<td>8</td>
<td>4.0</td>
<td>100.5</td>
<td>25</td>
<td>850</td>
<td>-</td>
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### Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th>Item</th>
<th>Major pollution sources</th>
<th>Measures for pollution control</th>
<th>Fume discharge (Nm³/h)</th>
<th>SO₂ discharge speed (kg/h)</th>
<th>SO₂ discharge concentration (mg/Nm³)</th>
<th>NOₓ discharge speed (kg/h)</th>
<th>NOₓ discharge concentration (mg/Nm³)</th>
<th>Discharge pipe height (m)</th>
<th>Control standard (SO₂ discharge concentration (mg/Nm³))</th>
<th>Control standard (NOₓ discharge concentration (mg/Nm³))</th>
<th>Analysis of up to standard</th>
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<tr>
<td>10</td>
<td>Radian tube roller bottom heating furnace 2#</td>
<td>Emission by high chimney</td>
<td>41000</td>
<td>3.7</td>
<td>90</td>
<td>4.1</td>
<td>100</td>
<td>30</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>11</td>
<td>Radian tube roller bottom heating furnace 3#</td>
<td>Emission by high chimney</td>
<td>41000</td>
<td>3.7</td>
<td>90</td>
<td>4.1</td>
<td>100</td>
<td>30</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>12</td>
<td>Double walking beam furnace 1#</td>
<td>Emission by high chimney</td>
<td>15430</td>
<td>1.4</td>
<td>90</td>
<td>3.7</td>
<td>239.8</td>
<td>30</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>13</td>
<td>Double walking beam furnace 2#</td>
<td>Emission by high chimney</td>
<td>15430</td>
<td>1.4</td>
<td>90</td>
<td>3.7</td>
<td>239.8</td>
<td>30</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
</tbody>
</table>
## Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th>Item</th>
<th>Major pollution sources</th>
<th>Measures for pollution control</th>
<th>Fume discharge (Nm³/h)</th>
<th>SO₂ discharge speed (kg/h)</th>
<th>SO₂ discharge concentration (mg/Nm³)</th>
<th>NOₓ discharge speed (kg/h)</th>
<th>NOₓ discharge concentration (mg/Nm³)</th>
<th>Discharge pipe height (m)</th>
<th>Control standard SO₂ discharge concentration (mg/Nm³)</th>
<th>Control standard NOₓ discharge concentration (mg/Nm³)</th>
<th>Analysis of up to standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Corrosion resistant plate pickling</td>
<td>Emission by high chimney</td>
<td>25000</td>
<td>-</td>
<td>-</td>
<td>5.5</td>
<td>240</td>
<td>40</td>
<td>850</td>
<td>240</td>
<td>7.5 (kg/h)</td>
</tr>
<tr>
<td>15</td>
<td>Rolled plate furnace</td>
<td>Emission by high chimney</td>
<td>150000</td>
<td>14.3</td>
<td>95</td>
<td>36.0</td>
<td>240</td>
<td>80</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>16</td>
<td>Coiler furnace</td>
<td>Emission by high chimney</td>
<td>60000</td>
<td>4.8</td>
<td>80</td>
<td>12.0</td>
<td>200</td>
<td>40</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>17</td>
<td>Lime roasting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Limekiln</td>
<td>Emission by high chimney</td>
<td>100000</td>
<td>6.5</td>
<td>65</td>
<td>24.0</td>
<td>240</td>
<td>25</td>
<td>850</td>
<td>-</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>19</td>
<td>4. Power generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>CCPP chimney 1#</td>
<td>Emission by high chimney</td>
<td>805000</td>
<td>34.3</td>
<td>65</td>
<td>42.2</td>
<td>80</td>
<td>60</td>
<td>Bases (GB13223)</td>
<td>Bases</td>
<td>80</td>
</tr>
</tbody>
</table>

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### Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th>Item</th>
<th>Major pollution sources</th>
<th>Measures for pollution control</th>
<th>Fume discharge (Nm³/h)</th>
<th>SO₂ discharge speed (kg/h)</th>
<th>SO₂ discharge concentration (mg/Nm³)</th>
<th>NOₓ discharge speed (kg/h)</th>
<th>NOₓ discharge concentration (mg/Nm³)</th>
<th>Discharge pipe height</th>
<th>Control standard</th>
<th>Analysis of up to standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>CCPP chimney 2#</td>
<td>Emission by high chimney</td>
<td>779000</td>
<td>34.3</td>
<td>65</td>
<td>42.2</td>
<td>80</td>
<td>60</td>
<td>(GB13223-2003) discharge speed 420kg/h</td>
<td>Up to the standard</td>
</tr>
<tr>
<td>20</td>
<td>CCPP chimney 3#</td>
<td>Emission by high chimney</td>
<td>779000</td>
<td>34.3</td>
<td>65</td>
<td>42.2</td>
<td>80</td>
<td>60</td>
<td>80</td>
<td>Up to the standard</td>
</tr>
</tbody>
</table>

Note: 1. The discharge concentration of fluoride in steelmaking system is below 1mg/Nm³, the limit is 6mg/Nm³, up to the standard;

2. The discharge concentration of fluoride in stainless steel acid mist purifying tower is below 9mg/Nm³, the speed is 0.225kg/h; the limit is 9mg/Nm³, 0.59kg/h; up to the standard.

3. CCPP is carried out bases the standard "section time 3" in (Emission standard of air pollutants for thermal power plants) (GB13223-2003), the discharge standard speed of SO₂ is the calculated value.
Judging from the water quality, the measures for water pollution control as well as the control results in Chinese iron & steel industry, the waste water in all production systems in Pusteel relocation is cycled after self-treatment, then purified by the advanced water treatment facilities (refer to engineering analysis), the water discharge in Pusteel relocation will certainly come up to the requirements of waste water discharge standard.

So, the measures for pollution control in Pusteel are available, pollution source discharge will be up to the standard, under the normal condition, the pollution control equipments are reliable and up to the standard in operation.

15.1.2 Advanced measures for environment protection

Stronger desires will be satisfied in Pusteel relocation to protect environment and reduce the amount of pollutant discharge. The effective measures for environment protection have been adopted in the design in line with the production process.

15.1.2.1 Measures for air pollution control

The following measures are adopted in the environment protection design in Pusteel:

(1). The necessary airtight measures have been taken for the feeding equipment system in conveying raw materials and adjuvant and at the dust source point by means of air draft or airtight cover, and the exhaust system. The system has to be reliable in the state of negative pressure and dust proof.

(2). The highly efficient bag filter dust collector adopted as the purifying equipment;

(3). The large central dust-catching system adopted, available for management and maintenance;

(4). The concentration control of air pollutant discharge is advanced. According to the state requirements for air pollutant discharge, the concentration of dust discharge of all air pollution sources will have to be below 100, 120mg/Nm3; except the converter OG system in Pusteel, the concentration control in all systems has to be below 35mg/Nm3 in the design.

(5). The coat gas, a byproduct of iron-melting, is used as fuel in steel rolling workshop heater and heat treatment furnace, and the low nitrogen burner is also used to reduce the discharge of SO2 and NOx.
15.1.2.2 Measures for water pollution control

The effective measures for waste water pollution control in operation will be taken in the project design. For instance, the clean cycled water will be recycled after cooling, with little of the thick cycled water into the recycling usage; the gas wash water and the slag wash water will be recycled after sedimentation process, with little into the recycling usage; the thick cycled water in steel making and steel rolling will be recycled after sedimentation, degreasing and filtering with little waste water discharge.

The waste water treatment center will be set up in the project to reduce the discharge of waste water and water pollution pollutants and increase water recycling. In workshops, the waste water up to the secondary standard of (Emission standard of waste water in Shanghai) will be conveyed to the waste water treatment center for further treatment, and 2/3 of the waste water up to the first standard will be recycled, 1/3 of the waste water into the Yangtze River after treatment in Shidongkou Water-treatment Plant. About 98.1% of the water in production will be recycled. (two stages)

Soil will be into the water network in the residential area after septic tank treatment, then into Shidongkou waste-water treatment plant with other waste water for purification.

15.1.2.3 The utilization of solid waste and the measures for the treatment

The solid waste, such as slag, sludge containing ferrite and rolling scale will be utilized both in and out of the company; the sludge containing chrome will be handled by the company with “permit for handling hazardous waste”.

Solid waste and hazardous waste will be handled to the rate 100%.

15.1.2.4 Control measures for equipment noise

The control measures for equipment noise, the sound insulation and noise elimination, are usually taken both at home and abroad. Namely, the sound insulation and noise elimination are adopted respectively between shops and equipments, and the equipments are matched with a muffler and base vibration reduction device.

15.1.3 Technical appraisal of the measures for environment protection

The measures for all air pollution sources, water pollution source and equipment noise source, as well as the measures for solid waste usage and for the safety, are the advanced and effective measures for pollution control both at home and abroad.
The comprehensive analysis indicates: the technology of pollution control in the project is practical, and the equipments are stable and reliable in operation with good performance and management; it is the practice and experience in Pusteel that guarantees the discharge of pollutants up to the requirements in the design after the completion and operation of the project.

Judging by the analysis of civilized production in the appraisal, the designed targets will be up to the class 1 of civilized production, based on comparison analysis of civilized production targets (united iron & steel enterprise) in (Standard for civilized production in iron & steelmaking industry) (draft). Namely, the civilized production is up to the international level (the analysis of the results on reference because of different production processes).

The comprehensive analysis indicates: the advanced technology of the measures for environment protection is applied, up to the top level of the industry at home.

15.2 Economical appraisal of measures for environment protection

Judging by the design papers of the project, included in the invest in the environment protection is the invest in waste gas and waste water purification, noise control, solid waste handling and usage, the facilities for environmental monitoring and the company greening, counting for 6.7%.

Based on the analysis of the measures for pollution control, the invest in environment protection is significant and it has brought in advanced, reliable equipments for pollution control; it will also help meet the demands of environment protection in the project and guarantee little impact on the environment after the completion and operation, and the advanced level at home in terms of comprehensive environment protection targets.

Baosteel is a star enterprise in metallurgical industry in China, both its management of environment protection and pollution control are the most advanced at home and advanced in the world. According to the statistics of Baosteel construction, its invest during stage 1 and stage 2 is 1.4 billion yuan, counting for about 4.2% of the total invest, the invest during the stage 3 is 2.626 billion, counting for 5.0% of the total.

The invest in environment protection in the project design is about 6.7% of the total, the percentage is 1.7% higher than that in Baosteel construction.

The above analysis indicates: the invest in environment protection of this project is significant; but it is necessary, feasible and reasonable for the
environmental sensitivity and environment protection in the construction area.

15.3 Brief summary

The analysis indicates: The technology of the measures for environment protection is advanced; the equipments for pollution control are stable and reliable in operation with good performance and management, up to the standard in operation under the normal condition. The discharge of pollutants is up to the requirements in the design after the completion and operation of the project. The technology of the measures is advanced; the discharge of pollutants is strictly controlled, up to the advanced level in the same industry at home.

Of all the same size enterprises in China, Baosteel has invested more significantly in environment protection in this project, but it is necessary, reasonable and feasible.
16 Analysis of emissions control

16.1 Background of emissions control

State Council held the 4th national meeting on environment protection in July, 1997, made certain (“The Ninth Five-year” plan of national environment protection and the future targets in 2010), issued (State Council’s decisions on questions of environment protection) and deployed “the schedule of pollutant emission control” and “greening plan for entering new century”. “The Ninth Five-year Plan” confirmed that the target of environment protection by the year 2000 is to hold back the deterioration of environment protection and ecological damage, and to improve the environment quality in some cities and areas. It is required in the “Decision” for the sake of this target that “Pollutant emissions in all industry pollution sources in China will come to the standards stipulated by the state government and local government by 2000; the total amount of pollutant emissions in the local area have to be limited in the total amount stipulated by the state”. The environment protection center will have to control new pollution sources and handle the old pollution sources and promote civilized production to hit these targets.

It is required by the state that the total amount of 12 pollutants’ emission will be limited: 3 pollutants in air pollution, that is fume, industrial dust and SO2; 8 pollutants in waste water pollution, that is COD, petroleum, cyanide, arsenic, mercury, lead, cadmium and hexavalent chrome; 1 pollutant in solid waste, that is the industrial solid waste.

It was in Shanghai in 1996 that the total amount of pollutants’ emission would be limited: 13 pollutants involved, they are 3 pollutants in air pollution, that is fume, industrial dust and SO2; 9 pollutants in waste water pollution, that is petroleum, COD, Cr\textsuperscript{6}, As, CN\textsuperscript{-}, Pb, Hg, Cd and ammonia nitrogen; 1 pollutant in solid waste, that is the industrial solid waste.

16.2 The limit of the total emissions stipulated by the state in Shanghai during “The Tenth Five-year Plan”

The limit of the total emissions in Shanghai during “The Tenth Five-year Plan” is required in “The Tenth Five-year plan, see Table 16-1.

Table 16-1 The limit of the total emissions stipulated by the state in Shanghai
16.3 The limit of the total emissions in Shanghai during “The Tenth Five-year Plan”

Based on the limit of the total emissions in Shanghai during “The Tenth Five-year Plan”, the government of Shanghai put forward the distribution of the limit of the total emissions in Shanghai during “The Tenth Five-year Plan” in Dec, 2002.

During “The Tenth Five-year Plan”, the total amount of pollutants' emission would be limited in Shanghai, the 6 pollutants of SO$_2$, fume, industrial dust, COD, ammonia nitrogen and the industrial solid waste. By the end of “The Ninth Five-year Plan", the hazardous pollution sources in waste water, such as petroleum, cyanide, arsenic, mercury, lead, cadmium and hexavalent chrome are under the control, so that during “The Tenth Five-year Plan”, the plan of the emissions control is cancelled in the state government and in Shanghai government, but the emissions must be controlled strictly in the management at county and district level. With the enhancement of management in the waste water network and waste water handling, the emissions of COD and ammonia nitrogen in the waste water are reduced mainly in waste water treatment plant, so that these two emissions control is not required in district and county, but the trapped waste water increased and waste water treatment in the area will be checked according to the targets and requirements in the “Tenth Five-year Plan” of water environment protection.

The pollutant emissions stipulated by Shanghai government in Baoshan district,
see Table 16-2.

Table 16-2 The pollutant emissions stipulated by Shanghai government in Baoshan district during “Tenth Five-year Plan”

<table>
<thead>
<tr>
<th>Limits</th>
<th>Unit</th>
<th>Emission in year 2000</th>
<th>Target in year 2005</th>
<th>Reduction than year 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO²</td>
<td>(10000 ton)</td>
<td>1.6213</td>
<td>1.6213</td>
<td>0</td>
</tr>
<tr>
<td>Fume</td>
<td>(10000 ton)</td>
<td>1.8217</td>
<td>1.7415</td>
<td>-4.4%</td>
</tr>
<tr>
<td>Industrial dust**</td>
<td>(10000 ton)</td>
<td>1.4370</td>
<td>1.3350</td>
<td>-7.1%</td>
</tr>
<tr>
<td>Trapped waste water increased</td>
<td>10000ton/day</td>
<td>10.91</td>
<td></td>
<td>-9.9%</td>
</tr>
<tr>
<td>Regional waste water treatment rate</td>
<td>%</td>
<td></td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Industrial solid waste</td>
<td>1. Emission</td>
<td>(10000 ton)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Utilization rate</td>
<td>%</td>
<td>92.9</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

* not including power plant and industrial power plant; ** including power plant and industrial power plant

16.4 The total amount of pollutant emissions in Pusteel

Based on (Pollutant emission permit in enterprises and institutions in Shanghai), the series number is 115000119, issued on Oct. 1, 2002, valid until Dec. 31, 2004. The permit limit of waste gas, waste water and the total amount solid waste in Pusteel, see Table 16-3.

Table 16-3 The permit limit of waste gas, waste water and the total amount solid waste in Pusteel

<table>
<thead>
<tr>
<th>Classifications</th>
<th>item</th>
<th>Name of pollutants</th>
<th>Unit</th>
<th>Permit limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste gas</td>
<td>1</td>
<td>SO₂</td>
<td>t/a</td>
<td>1355.1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Fume</td>
<td>t/a</td>
<td>253.05</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Dust</td>
<td>t/a</td>
<td>2129.34</td>
</tr>
<tr>
<td>Waste gas</td>
<td>1</td>
<td>Industrial waste water emission</td>
<td>t/d</td>
<td>94755.45</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Life waste water emission</td>
<td>t/d</td>
<td>5504</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>COD</td>
<td>kg/d</td>
<td>8000</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Petroleum oil</td>
<td>kg/d</td>
<td>916.703</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Ammonia nitrogen</td>
<td>kg/d</td>
<td>185.424</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Hexavalent chrome</td>
<td>kg/d</td>
<td>3.179</td>
</tr>
</tbody>
</table>
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

16.5 Emissions of pollutants under control in this project

16.5.1 Emissions of waste gas, waste water under control in this project

Emissions of waste gas, waste water under control in Pusteel project, see Table 16-4.

Table 16-4  Emissions of waste gas and waste water pollutants in the project

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Name of pollutants</th>
<th>Unit</th>
<th>Stage 1</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste gas</td>
<td>SO²</td>
<td>t/a</td>
<td>692.1</td>
<td>1332.9</td>
</tr>
<tr>
<td></td>
<td>Dust</td>
<td>t/a</td>
<td>841.7</td>
<td>1509.3</td>
</tr>
<tr>
<td>Waste gas</td>
<td>Amount of waste water</td>
<td>10000m³/a</td>
<td>193.92</td>
<td>200.39</td>
</tr>
<tr>
<td></td>
<td>COD</td>
<td>t/a</td>
<td>135.75</td>
<td>140.27</td>
</tr>
<tr>
<td></td>
<td>Petroleum oil</td>
<td>t/a</td>
<td>9.70</td>
<td>10.02</td>
</tr>
<tr>
<td></td>
<td>Volatile phenol</td>
<td>t/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total hydrogen cyanide</td>
<td>t/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hexavalent chrome</td>
<td>t/a</td>
<td>0.050</td>
<td>0.037</td>
</tr>
<tr>
<td></td>
<td>Ammonia nitrogen</td>
<td>t/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid waste</td>
<td>Ferric slag, steel slag, air scale, collecting dust</td>
<td>10000m³/a</td>
<td></td>
<td>158.72</td>
</tr>
</tbody>
</table>

16.5.2 Comparison between the emissions of waste gas, waste water and the permit emissions in the project

Comparison between the emissions of waste gas, waste water and the permit emissions in Pusteel relocation is indicated in Table 16.5.

Table 16.5 Comparison between the emissions of waste gas, waste water and the permit emissions in the project
<table>
<thead>
<tr>
<th>Classifications</th>
<th>Name of pollutants</th>
<th>Unit</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Permit limit</th>
<th>Equivalent to permit limit 1</th>
<th>Equivalent to permit limit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste gas</td>
<td>SO₂</td>
<td>t/a</td>
<td>692.1</td>
<td>1332.9</td>
<td>1355.1</td>
<td>51.07%</td>
<td>98.36%</td>
</tr>
<tr>
<td></td>
<td>Fume</td>
<td>t/a</td>
<td></td>
<td></td>
<td>253.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dust</td>
<td>t/a</td>
<td>841.7</td>
<td>1509.3</td>
<td>2129.34</td>
<td>39.53%</td>
<td>70.88%</td>
</tr>
<tr>
<td>Waste water</td>
<td>Industrial waste water emission</td>
<td>t/d</td>
<td>5232</td>
<td>5760</td>
<td>94755.45</td>
<td>5.52%</td>
<td>6.08%</td>
</tr>
<tr>
<td></td>
<td>Life waste water emission</td>
<td>t/d</td>
<td></td>
<td></td>
<td>5504</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>COD</td>
<td>kg/d</td>
<td>425.04</td>
<td>436.8</td>
<td>8000</td>
<td>5.31%</td>
<td>5.46%</td>
</tr>
<tr>
<td></td>
<td>Petroleum oil</td>
<td>kg/d</td>
<td>30.36</td>
<td>31.2</td>
<td>916.70</td>
<td>2.85%</td>
<td>3.14%</td>
</tr>
<tr>
<td></td>
<td>Ammonia nitrogen</td>
<td>kg/d</td>
<td></td>
<td></td>
<td>185.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hexavalent chrome</td>
<td>kg/d</td>
<td>0.164</td>
<td>0.119</td>
<td>3.179</td>
<td>5.16%</td>
<td>3.74%</td>
</tr>
<tr>
<td></td>
<td>Volatile phenol</td>
<td>kg/d</td>
<td></td>
<td></td>
<td>0.303</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total hydrogen cyanide</td>
<td>kg/d</td>
<td></td>
<td></td>
<td>3.07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It can be seen that the pollutant emissions of waste gas, waste water are below the total permit emissions after the completion of Pusteel relocation, counting for 2.85%-98% of the total.

16.6 Suggestion

(1) Dust emission in Baoshan area is noticeable, and most of the dust emission is the dust emission on the road, at the construction site and in the stork yard.

(2) Shanghai’s iron & steelmaking industry is gathering in Baoshan area, the allocation of production and processes will be readjusted in Baosteel Group; the clean energy and advanced processes will be adopted, reducing the emissions at the pollution source and reducing the waste gas impact on the environment of Baoshan. The target of the comprehensive environment clean-up in Wusong
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

Industrial Park and Baoshan area will be reached.
17 Consistency Analysis of Industrial Policies and Plans

17.1 Consistency Analysis of Construction Project and Industrial Policies

17.1.1 Consistency Analysis of the State’s Industrial Policies

(1) The State’s Industrial Technology Policies

The State Economic and Trade Commission, Ministry of Finance, Ministry of Science and Technology and State Bureau of Taxation jointly issued the State’s Industrial Technology Policies in July, 2002, which focuses on the Tenth Five-year Plan while giving attention to the development in the five years after the Tenth Five-year Plan. It is consisted of the technology policy compendia of industry, agriculture and defense science and technology, formulating the industrial technology policies for new conditions and clarifying the strategic goal and stress of the development of the industrial technology of our country. It points out in Part 4—“Development Direction of the Major Industrial Technologies” that “(in terms of raw material, iron and steel) stresses should be given to such hi-tech areas as the melting reduction, near net shape continuous casting and next-generation of iron and steel materials that will affect the development of the iron and steel industry in long term; optimization of steel manufacture flow route, new-tech development of low-cost and energy-saving sintering and coking, integrated energy-saving and environmental protection technology of the blast furnace, high-effective electric steel making technology; improvement of the quality of the metallurgical products, technological skill development of the clean steel production, controlled rolling and cooling and intellectual technology...”.

Item 6 of the Interim Provisions for Promoting Industrial Structure Regulating the State Development and Reform Commission emphasizes that “the core is to improve the whole quality of the industry and accelerate updating of the industrial technological equipments. Accelerating reconstruction of the traditional industry will be the break-through to the ‘information technology driving industrialization’”. The use of new, high and applicable technologies are encouraged to reform and enhance such traditional industries as machinery, automobile, iron and steel, petrochemistry, nonferrous metal, coal, light industry, textile and construction material, so that the promotion of the traditional industrial technologies can be expedited.”

Furthermore, in order to prevent low-level construction from overlapping, update and upgrade the manufacturing technique, equipments and products, the nation has, based on the relevant national lows and regulations, formulated the Announcement on Elimination list of out-of-date Productivity, Technology and Products (the Third so far), the Announcement on Prohibition list of Overlapping Construction in Industrial and Commercial Investment, Catalogue of Industries, Products and Technology Currently Particularly Encouraged by the State for Development (edited in 2000), giving deadlines to eliminate the equipments and technologies that are out-of-date, high energy-consuming and polluting, no more such construction is allowed. In December, 2003, Circular of the General Office of the State Council of the People’s Republic of China, on Transmitting and Issuing Several Opinions of the National Development and Reform Commission and Other Departments on Curbing Irrational Investment in Steel, Electrolytic Aluminum and Cement Industries (Decree No.103[2003] of the State Council of the People’s Republic of China) was issued. All localities and departments are...
requested to "clean up the investment of the electrolytic aluminum and cement projects". The Circular says: "in the face of fast adjustment of the international industrial structure and further open-up market, every departments of the State Council have to accelerate the steps of revising development policies and plans for steel industry, directing adjustment and update of the industrial structure, adjusting the strategic arrangement, pushing on the industrial cooperation and reshuffle and, making the best use of resources at home and abroad. Supplying capability of such needed, high value-added steels as plate and tube is encouraged to increase, such products with surplus production, poor quality and high pollution as long wire bar should be limited, clean production must be realized and the whole competitive capability of the national steel industry in the international market should be enhanced." Meanwhile, in order to raise the admission conditions to the steel market (operating area for the sintering machine should be 180m2 or above, converter capacity 100 tons or above, electric furnace 60 tons or above), and for "the existing manufacturers to be complied with above conditions by improving technology and equipments", "the nation and local administrations shall, in principle, no longer approve any new project of steel joint adventure or independent blast furnace plant." Catalogue of Low-end, Overlapping Construction Projects (2004) (Decree No.746[2004] of State Development and Reform Commission) jointly issued by the State Development and Reform Commission, Bank of China and China Banking Regulatory Commission has also made similar regulations on the steel industry.

(2) Consistency Analysis

The techniques adopted by this project are encouraged by the Catalogue of Industries, Products and Technology Currently Particularly Encouraged by the State for the Development(edited in 2000) and the Catalogue of Readjustment of Industrial Structure (draft). For example, melting reduction process of Corex, direct reduction process of Midrex and converter process are all major high-tech metallurgical industries. The melting shop is capable of molten iron pretreatment (desulfurization), outside molten steel refining (VD, VOD and LF). The sponge iron produced with Midrex is closed discharge with molten charge about 650°C to the electric furnace and continuous casting to the regenerative furnace. The regenerative furnace is heat accumulating and the coal gas from Corex or Midrex is recyclable.

This project is part of the relocations for World Expo 2010 Shanghai. Pudong Iron & Steel Co Ltd will take the opportunity of relocation to improve its technology completely and eliminate the technique of cupola furnace and other out-of-date manufacturing techniques as well as facilities, so that the product quality of the company could be improved.

This project of removal and reconstruction is, therefore, in line with the national policies for industry and technological equipments.

This project is part of the relocations for World Expo 2010 Shanghai. Pudong Iron & Steel Co Ltd will take the opportunity of relocation to improve its technology completely and eliminate the technique of cupola furnace and other out-of-date manufacturing techniques as well as facilities, so that the product quality of the company could be improved.

This project of removal and reconstruction is, therefore, in line with the national policies for industry and technological equipments.
17.1.2 Consistency Analysis of Industrial Policies

(1) Relevant Industrial Policies

The Tenth Five-Year Plan for Metallurgical Industry points out in its “guidelines and general principles” that “we should track and give greater emphasis on the research and development of such major cutting edge technology and equipment as melting reduction process, thin strip continuous casting and clean steel production...to drive the enhancement of the whole metallurgical technology and achieve a great-leap-forward development.” It says in the “main points” (heavy and medium plates) that “(now) the production proportion of special plates, such as wire and tube steels, high-strength ship building plate, steels for pressure vessel and bridge, are rather low. There is a big gap in the quality of products compared with the advanced technology abroad. The mature enterprises should, beginning with steel making, create a set of professional production lines of heavy and medium plates, eliminate some of the medium plate mills that are out-of-date...” It also points out that “special emphasis should be given to the promotion and popularization of such key technologies as ball and ball sintering, pretreatment of molten steel, outside refining, high-effect continuous casting and high-precise milling... adopting the mature, state-of-date technologies of continuous casting hot charge, rolling in one heat, recovering and reusing the gas, energy saving of electric furnace and automatic control of metallurgy, to optimize the production flow of the industry and lower the cost...”

(2) Consistency Analysis

The Corex project is melting reduction process and Midrex is direct reduction process which, apart from converter process, are all major forefront technologies currently used in metallurgical industry. With these advanced technical skills and equipments, Pudong Iron & Steel Co Ltd would improve the quality of its heavy and medium plate products. The sponge iron produced with Midrex is closed discharge with molten charge about 650°C to the electric furnace and continuous casting to the heating furnace. The gas from Corex will all be recovered and then applied to the production of sponge iron with Midrex. The gas recovered from Midrex will be used as the fuel for all heating furnaces and heat treating furnaces of the plant.

So, the project is in accordance with the requirements of metallurgical industry.

17.1.3 Consistency Analysis of the Local Industrial Policies

(1) Relevant Local Industrial Policies

Chapter 3 (“Economic Development”) of the Shanghai National Economic and Social Development Outline of the Tenth Five-Year Plan notes that “Baoshan Steel Group shall be encouraged to take its advantage to make itself one of the largest, highly modernized and the most competitive steel industries in our country. It should continue to control its total capacity, optimize the structure, expedite the technology progress, eliminate the out-of-date equipments and techniques and improve the production environment. Stress should be given to develop the steels for automobile making, ship building, as well as electric steel, oil tube steel, stainless steel and advance construction steel, to make it one of the competitive steel production bases in our country.”

Guideline for Industrial Development and Distribution notes that “In terms of industrial development and during the Tenth five-year Plan, Shanghai will
primarily establish a new industrial structure with the high-tech industries as the leader, the basic raw material industries the supporter, modern-equipped industries the backbone and completed with the metropolitan type of industries. Emphasis shall be give to develop the six pillar industries of electronic information, automobile, power station equipments and electromechanical products, petrochemistry, fine chemical industry, top steel and biomedicine...In terms of the industry distribution, ‘the principle is to liquidize storage, make best use of increment, optimize the lay-out and increase radiation’. Construction of the major four industrial bases--information industry, auto center, chemical industry area and top steel should be accelerated. The general industrial distribution of ‘three-ring distribution’ should be further accomplished. That is , the city center is the axis and the inner and outer rings the boundaries. While the metropolitan type of industries are mainly within the inner ring, the area between the inner and outer rings will be consisted of the metropolitan type of industries, high-tech industries and supporting industries. The equipment industries and basic raw material are mainly located outside of the outer ring. 

The Tenth Five-Year Plan for Fine Steel Industry, Shanghai points out that, during the Tenth Five-Year, the main task of Shanghai industrial development is to adjust the distribution of the steel industries, and the industries will be distributed in accordance with market demand and fine steel strategy. The product structure will be adjusted and modern technology and equipments realized, with effort to establish a set of modernized professional production lines.

(2) Consistency Analysis

The project is one of the major steps of Baoshan Steel Group towards fine steel base, and one of the "six pillar industries" defined by the Guideline for Industrial Development and Distribution. Its leading products—wide heavy plate—is in the list of the Guideline to develop. Its new location is to be within the outer ring of Luojing district. This project, therefore, is in accordance with the guideline of Shanghai local industrial policy.

17.2 Consistency Analysis of Construction Project and Industrial Policies

17.2.1 Consistency Analysis of Rules Relating World Expo 2010 Shanghai

(1) Relevant Rules of World Expo 2010 Shanghai

Plan for World Expo 2010 Shanghai notes that the site of World Expo 2010 will be located in the waterfront between Lupu bridge and Nanpu bridge with proposed land area of 5.4km2. With integrated planning, the riversides will be developed synchronously, so that they can function correspondingly with harmonious landscapes.

The International Schematic Planning for Huangpu Riverside Area in Shanghai notes that the planning aim is to “integrate the development of the riversides, improve the natural biological environment, open up vigorous public activity lines, create a waterfront landscape with strong urban features and, a leisure and sightseeing zone with water and green landscape from north to south to make Huangpu River a’ river of the people.” The south section of Huangpu river (Nangpu—Lupu bridge) will be mainly for exhibition, cultural entertainment and inhabitance. As the site of World Expo 2010, this area will, combining with the use of the facilities after World Expo 2010, have an integrated planning and conduction.
World Expo 2010 Shanghai is the one to be held in a developing country. It is essential for a rising China to speed up the construction progress of a modern, international metropolis in Shanghai.

The fact that the World Expo 2010 is sited in the waterfront of Huangpu River is significant for the reorganization of the central urban industries and the old area into an important cultural exhibition center and unique inhabitance area. Pusteel, with a history of 100, is located within the site of World Expo 2010. Its relocation will be the base of accomplishing the project.

Strategically, the removal is to begin with hundreds of enterprises and public institutions that make up 70% of the area. The first removal framework agreement was signed so far, by the end of April, and the removal work of the enterprises, public institutions and citizens within this area has been essentially started. Under the schedule, all land within the area of World Expo 2010 will be cleared in 2006, which means that Pudong Iron & Steel Co Ltd. have to complete removal in 2006.

17.2.2 Consistency Analysis of Shanghai General Rules

(1) General Plan of Shanghai (1999-2020)

In Item 20 (Industry), Chapter 4 (Plan for Industrial Development) of the General Plan of Shanghai (1999-2020) it says that “something to be done and something not to be done.” With the “two high” (high-tech and high value-added industry) as the core of industrial development, the structure is to be adjusted and optimized, the industries upgraded to create a modern industrial system featured with high-tech, deep processing and integrated industries, and with the industrial structure, economic scale and overall power primarily compatible to an international central city. While the urban industries will be developed mainly within the inner ring, the area between the inner and outer rings will accommodate to the urban, high-tech and supporting industries. The steel, petrochemical and automobile industries will be developed outside the outer ring.

(2) Consistency Analysis

The General Plan of Shanghai points out that the steel, petrochemical and automobile industries are to be developed outside of the outer ring. Looking at the guide of the industries of the districts and counties outside of the outer ring (see table 17-1), it shows that only the direction of the industrial development of Baoshan is aimed at the steel industry for the pillar industry. Therefore, it is in accordance with the requirements of the General Plan of Shanghai to move Pudong Iron & Steel Co Ltd. to Luojing district of Baoshan.

17.2.3 Consistency Analysis of General Plan of Baoshan District

(1) Outlines of General Plan of Baoshan District Shanghai (2003-2020)

According to Chapter 2 (“nature, scale and goal of the district”) of the Outlines of General Plan of Baoshan District Shanghai (2003-2020), Baoshan district is defined as the “bridgehead” in the development zone which connects the northern Shanghai with the cities on the Yangtze Delta; the industrial pivot of fine steel and the extending industries on the Yangtze Delta, shipbuilding base of world-class, goods distribution service base in northern Shanghai, an important
part of the Shanghai International Shipping Center; a new, modern riverside city with long historical culture and beautiful landscape that is good for living. According to Item 1 ("Industrial Development") of Chapter 4 ("Plan for Industrial Development"), the secondary industry shall give priority to the fine steel, shipbuilding as well as the extending industry, with the effort to optimize and upgrade the industrial structure, and increase the benefit output of the industrial land. Chapter 4 ("industrial distribution") points out that the industrial distribution of the whole Baoshan district is divided into four areas, with the suburb of northern area being the core of Baoshan industry, an important base of the fine steel and extending industries of China will be established..
Table 17-1 Guide of Industries of the Districts and Counties outside of Outer Ring

<table>
<thead>
<tr>
<th>No</th>
<th>Dist (county)</th>
<th>Industry Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baoshan</td>
<td>Mainely steel, fine steel &amp; extending industry, shipbuilding, port and harbor machinery</td>
</tr>
<tr>
<td>2</td>
<td>Jiading</td>
<td>Auto making, communication equipments, new materials, modern biology, electric-optics and other high-tech industries</td>
</tr>
<tr>
<td>3</td>
<td>Qingpu</td>
<td>Electronic information, modern textile, bio-medicine, sophisticated electromachine, etc.</td>
</tr>
<tr>
<td>4</td>
<td>Minxing</td>
<td>Power station equipment, machine, fine chemical industry, neo-construction material, light industry, civil nuclear tech and other new and high industries.</td>
</tr>
<tr>
<td>5</td>
<td>Songjing</td>
<td>Electronic information and modern manufacturing.</td>
</tr>
<tr>
<td>6</td>
<td>Jinshan</td>
<td>Petro-chemical, fine chemical and textile industries.</td>
</tr>
<tr>
<td>7</td>
<td>Fengxian</td>
<td>Light textile, fine chemistry, medical chemistry and modern biology.</td>
</tr>
<tr>
<td>8</td>
<td>Nanhui</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>9</td>
<td>Chongming</td>
<td>ecological Island, no project with pollution of “three wastes” is allowed, light industries like garment, commercial products and toy are encouraged.</td>
</tr>
</tbody>
</table>

(2) Consistency Analysis

Pudong Iron & Steel Co Ltd. is planned to move to the administrative area of Luoqing town in Baoshan district, with Baoshan Steel Co Ltd. 2km to the northwest, the golden line of Yangtze River in the east, close to Bei yunchuan road of suburb ring currently under construction in the south and bordering on the planned high way to Jiangsu province in the northwest. The site selected for the project is now planned as the industrial land in the Outlines of General Plan of Baoshan District Shanghai (2003-2020), and the new location of Pudong Iron & Steel Co Ltd. is therefore in accordance with the industrial arrangement of Baoshan district.

After removing to Luoqing, the production capacity of Pudong Iron & Steel Co Ltd. is to reach 2,063,000 t/a for the first step, and 3,455,000 t/a for the second. In addition to its main products of heavy and medium plates, the production of the high value-added alloy and stainless steel of heavy and medium plates will also be included, which is in line with the industrial orientation of Baoshan district.

This shows that the removal of Pudong Iron & Steel Co Ltd. is in line with the industrial orientation and lay-out, as well as the requirements of the general plan of Baoshan district.
18 **Analysis of environment economic gain or loss**

The analysis of environment economic gain or loss is an important part of the appraisal of the impact on the environment; its main purpose is to appraise the gain of the investment in the environment protection and estimate the direct and indirect benefits from the pollution prevention measures, it's the comprehensive appraisal of the environmental benefit and social benefit in the project.

18.1 **Building size and investment of the project**

18.1.1 **Investment and operation cost in the project**

1) **Total investment of the project**

Included in Pusteel relocation are finished products dock, stock yard, Corex ironmaking plant, direct reduction plant, steelmaking and continuous casting plant, heavy plate, Steckel mill plant, medium-heavy plate distribution center (listed separately), oxygen plant, air compressing station and CCPP industrial power plant, etc.

The total investment of the project is RMB 17.32 billion, including, among other things, building engineering, equipments, equipment upgrading and equipment installation, tools and apparatus, other engineering, contingency fund and interests during construction period.

2) **Operation cost**

Based on the pre-feasibility study report, the total cost in the year of designed capacity is RMB 807,709 million, including raw material, labor costs and welfare costs, manufacturing costs, management cost, selling cost as well as technical royalty and depreciation, amortization.

18.1.2 **Environment protection investment**

The environment protection investment in Pusteel relocation is RMB1.166 billion. The environment protection investment in all facilities is indicated in Table 18-1.
Table 18-1 The summary table of environment protection investment

<table>
<thead>
<tr>
<th>item</th>
<th>Pollutantion source</th>
<th>Investment (RMB 100 million)</th>
<th>Percentage of investment</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Waste water</td>
<td>4.59</td>
<td>39</td>
<td>Waste water treatment system at the stock yard, indirect cooling water from Corex furnace and deacidizing shaft furnace, gas washing water, granulating slag treatment system, casting plant waste water treatment system; indirect cooling water in continuous casting system, converter gas purification, direct cooling in RH and VD furnaces, direct cooling in continuous casting and mill scale waste water treatment system in steelmaking; indirect cooling water, direct cooling water, high pressure descale, rinsing iron scale waste water and pickling waste water in steel rolling; and central waste water treatment center.</td>
</tr>
<tr>
<td>2</td>
<td>Waste gas</td>
<td>4.40</td>
<td>38</td>
<td>Raw material stock yard, the dust collecting devices in Corex furnace, deacidizing shaft furnace, steelmaking, steel rolling and lime workshop.</td>
</tr>
<tr>
<td>3</td>
<td>Noise</td>
<td>1.04</td>
<td>9</td>
<td>Vibration reduction, sound insulation, silencing measures</td>
</tr>
<tr>
<td>4</td>
<td>Solid waste</td>
<td>0.70</td>
<td>6</td>
<td>Solid waste stock yard</td>
</tr>
<tr>
<td>5</td>
<td>greening</td>
<td>0.55</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>0.38</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>11.66</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

18.1.3 Annual operation cost of environment protection facilities

1) Annual operation cost of waste water treatment facilities

The waste water is from Waste water treatment system at the stock yard, indirect cooling water from Corex furnace and reduction shaft furnace, gas washing water, granulating slag treatment system, casting plant waste water treatment system; indirect cooling water in continuous casting system, converter gas purification, direct cooling in RH and VD furnaces, direct cooling in continuous casting and mill scale waste water treatment system in steelmaking; indirect cooling water, direct cooling water, high pressure descale, rinsing iron scale waste water and pickling waste water in steel rolling. In workshops, the waste water up to class 1 of (Emission standard of waste water in Shanghai) will be conveyed to the waste water treatment center for further treatment, and 2/3 of the waste water up to class 2 will be recycled, the rest of waste water into the Yangtze River after treatment in Shidongkou Water-treatment Plant.
The total operation cost of the waste water treatment system is, among other things, involved with the cost of agents, material expenses, labor cost, water, electricity, gas cost and maintenance and depreciation. According to the estimation, the clean circulation water and muddy water treatment cost in all shops are respectively RMB 0.1yuan/m3 and RMB 0.2yuan/m3, and the cost in the water treatment center is RMB 0.1yuan/m3. The total annual operation cost is RMB150 million yuan.

2) Annual operation cost of waste gas treatment facilities

The dust-containing waste gas produced in the project comes mainly from raw material stock yard, Corex furnace, reduction shaft furnace, steelmaking, steel rolling process as well as lime workshop, and it will be emitted from the stack after being treated by the dust collector.

The cost of waste gas treatment occurred primarily in respect of electrical energy and fuel, and relatively lower, totaling about RMB 4.5 million Yuan of annual operation cost.

3) The operation cost of solid waste treatment

Most of the solid waste can be recycled. The waste to be handled is sludge and waste oil, and they will be handled by the company with a permit. The total cost of solid waste treatment is RMB 2.3 million Yuan each year.

It can be found that the environment protection facilities will be on smooth operation at the cost of RMB156.8 million Yuan at least each year.

18.2 Analysis of environment protection benefit

18.2.1 Economic benefit of environment protection

The economic benefit of pollution control measures for the environment protection implies the following two aspects: one is the direct economic benefit; the other is the indirect economic benefit. Direct economic benefit is the value of the product that the environment protection measures can bring in directly; the indirect economic benefit is the reduced loss and the compensation after the pollution clean-up.

18.2.1.1 Direct economic benefit

The direct economic benefit in the project implies the following:
1) The water recycled

The cooling water and waste water (the indirect cooling water, gas washing water, granulating slag treatment system in Corex furnace and reduction shaft furnace, steelmaking continuous casting system and steel rolling process) will be recycled evenly after cooling and simple treatment. The total amount of water used in the company is 123769m³/h, the fresh water supplied is 2333m³/h, the waste water discharged is 26m³/h, the percentage of recycled water is 98.1%, highly above the current percentage 80% in Pusteel.

After the modification in the project, about 101.886m³ fresh water can be saved every year, because of the high percentage of recycled water. If the industrial water is estimated at the price of 1.3yuan/m³, the water cost of 117.447 million Yuan can be saved each year, deducting the average cost of waste water treatment 0.15yuan/m³.

2) The solid waste recycled

Most of the solid waste (such as the water granulated slag, gas parget, collecting dust and waste refractory materials produced in Corex process; gas parget and waste refractory materials produced in Midrex process; desulphurizing slag, slag and collecting dust in steelmaking process; iron scale, waste refractory materials and waste steel) can be sold to the relevant enterprises for recycling. Based on the pre-feasibility study report, the mere sales income from recycling waste carbon steel, waste stainless steel, molten iron desulphurizing slag, gas parget can reach 221.47 million yuan, 170.63 million yuan, 5.2 million yuan and 2 million yuan respectively.

It can be found that the direct economic benefit of environment protection is about 1573.77 million yuan every year.

18.2.1.2 Indirect economic benefit

The indirect economic benefit in the project implies the reduced drainage cost by recycling. Based on the situation that the water resource in Pusteel is reused, an additional drainage cost will be increased without recycling if estimated at the drainage cost of 1.2 yuan/m³.

It can be found that the indirect economic benefit of environment protection is about 2.8 billion yuan every year.
18.2.2 Environmental benefit

The environmental benefit in the project implies the reduced emissions of waste water, waste gas and solid waste after treatment to the outside of the environment.

1) The amount of the treated waste water is 2.45 million m³/a, and the treated waste water can come to class 1 of (Standard for Comprehensive Wastewater Discharge in Shanghai). There will be less emission of CODcr 9575t/a, Oil 90t/a every year to the outside environment and the pollution of the water body in the outside environment will be decreased.

2) The main waste gas in the project is the dust containing waste gas and it can, after treatment, come to (Emission standard on atmospheric pollutants) before its emission. Based on the average efficiency of the dust collecting devices, there will be less dust emission of 153028t/a, and the tension of environment pollution and the damage to the people's health will be relieved significantly. So the environmental benefit of the waste gas treatment in the project to the employees and the surrounding environment is remarkable.

3) The hazardous waste in the project is the sludge containing chrome (2000t/a) and waste oil (300t/a) every year, and they are assigned to the company with a permit for treatment and the secondary pollution will be avoided.

4) The percentage of the recycled water will be raised from 80% to 98% after the relocation. The fresh water of 1018.86 million m³/a can be saved and large quantity of the discharged waste water that will pollute the environment will be decreased.

5) Most of the solid waste (such as Corex ferric slag, steel slag, slag from the desulphurizing of iron molten, mill scale, sludge containing ferrite and collecting dust, waste fire-retardant materials) will be sold to the relevant enterprises for recycling to save the resource and reduce the solid waste pollution to the environment.

6) In addition to this, Pusteel is an old iron & steel enterprise and its processes and equipments are out of date. Though there have been some greater changes of production structure and civilized production in the past years, the situation of environment protection has not yet improved significantly, Pusteel is the number one source of pollution at the selected World Expo site in the Zhoujiadu area. Therefore, the environment quality in the current area will improve greatly after the relocation project, especially the air quality in the environment will
18.3 Analysis of environment economic gain or loss

The investment in environment and the total investment in the construction can be done by proportion in the following:

\[ H_J = \frac{ET}{JT} \times 100\% \]

In the formula:

- \( H_J \) — the proportion between the investment in environment protection and the total investment in the construction;
- \( ET \) — the investment in environment protection, ten thousand yuan;
- \( JT \) — the total investment in the construction, ten thousand yuan;

The investment in environment protection is 1.166 billion yuan, the total investment is 17.32 billion yuan, counting for 6.7% of the total investment.

In the project, the annual operating cost of environment protection is 156.80 million yuan, and the production cost is 8077.09 million yuan. The percentage of proportion between the operating cost of environment protection and the production cost is 1.9%.

The annual production value is 10517.13 million yuan, and percentage of proportion between the operating cost of environment protection facilities and the annual production value is 1.5%.

18.4 Analysis of social benefit

The social benefit of the project implies the following:

1) The current location of Pusteel is in the area of the selected World Expo. site, so the project of Pusteel relocation will improve significantly the environment situation in the area of World Expo. site, facilitate Shanghai’s image and improve the environment of investment remarkably.

2) With economic strength and competitive power, as well as the long time practice
and management in iron & steel industry, Pusteel represents the advanced level in China especially after importing the special medium and heavy plate process and technology. By taking the advantage of the relocation and reformation and importing advanced technology and equipments, Pusteel will improve its the management and promote the modernization of iron & steel industry of our country, and excite the development of the relevant matching industries.

3) The main reformation involved in the relocation project is carbon steel billets, alloy steel billets and stainless steel billets, of which 70% is self-made plates of all kinds; the completion of the project will satisfy not only the desire of the market and the strategic development of the domestic iron & steel industry, also the elevation of people’s living conditions.

18.5 The appraisal of the environment economic indicator

The investment in environment protection is counting for 6.7% of the total investment. As to the proportion between the investment in the environment protection and the total investment, Shanghai Economic and Trade Commission requires that the investment in the environment protection have to be enhanced, counting for 7%. In regard to this percentage, the proportion of the investment in environment protection in Pusteel is nearly up to the requirement. It means Pusteel values environment clean-up highly in the relocation project.

Generally speaking, the operating cost of environment protection is properly 2% smaller than the enterprise’s annual production value. In this situation, the enterprise can endure the pressure of the environment clean-up and the pollution clean-up will not be a burden to the enterprise and will not threaten the existence and development of the enterprise. The operating cost of environment protection facilities in Pusteel is counting for 1.5% of the total annual production value, lower than 2%, implying that Pusteel can afford the pollution clean-up and the clean-up will not be a burden to the enterprise.

18.6 Brief summary

Table 18-2 is a summary of items and costs in the economic analysis of the environment protection.

Table 18-2: A summary of items and costs in the economic analysis of the environment protection

<table>
<thead>
<tr>
<th>Items</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment of the project</td>
<td>17.32 billion yuan</td>
</tr>
<tr>
<td>Description</td>
<td>Value</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Total operating cost</td>
<td>8.077 billion yuan</td>
</tr>
<tr>
<td>Annual production value</td>
<td>10.52 billion yuan</td>
</tr>
<tr>
<td>Investment cost in environment protection facilities</td>
<td>1.166 billion yuan</td>
</tr>
<tr>
<td>Annual operating cost of environment protection facilities</td>
<td>157 million yuan</td>
</tr>
<tr>
<td>The economic benefit of environment protection facilities</td>
<td>2.8 billion yuan</td>
</tr>
<tr>
<td>Environment protection investment / Total investment</td>
<td>6.7%</td>
</tr>
<tr>
<td>Annual operating cost of environment protection facilities / Production cost</td>
<td>1.9%</td>
</tr>
<tr>
<td>Annual operating cost of environment protection facilities / Annual production value</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
19. The public participation

19.1 The purpose of the public participation

Pusteel is scheduled to be entirely relocated to Luojin area in Baoshan district for the sake of World Expo. Shanghai 2010. As a large-sized iron & steel enterprise, its relocation project shall be involved with the relevant environment and social problem, such as moving and tearing down farmhouses and allocation, pollution control during the construction and operation which will probably bring adverse effects to the local residents’ work and life. To ensure the benefits of the public and to improve environment pollution control, the work team investigated, consulted the public in the area of construction and collected their rationalization proposals during the relocation of the project. After hearing from the public's opinion, the work team will bring forward some mitigation measures for adverse effect due to the construction, and warn the relevant units and departments to pay much attention. This will facilitate the economic and environmental development in the construction and minimize the adverse effect to social and economic environment due to the construction.

19.2 Survey method

A large area and many aspects will be involved in Pusteel's relocation that is directly or indirectly related to the citizens, and two survey methods are used to consult the people involved in the large area of the construction of the project.

19.2.1 Announcement

The survey was consigned by the work team to Shanghai environment protection propaganda and education center. It was made public on Shanghai hot line (http://www.envir.online.sh.cn) from September 9, 2004 to October 12, 2004 under the title (Luojin relocation project of Baosteel Group Shanghai Pudong Iron & Steel Co., Ltd). The outline of the project was made known to the citizens and the possible effects were mentioned; a phone hot line and an E-mail address were available for the public’s convenience to get further information of the project and to express their ideas and suggestions. The window of homepage of Shanghai environment protection hotline was opened with the title, see Table 19-1.
The survey address on the internet: [http://www.envir.cn/20040909.htm](http://www.envir.cn/20040909.htm), see Picture 19-2.

Picture 19-1 Survey title is seen in the window of announcement
Picture 19-2 Real time effect pictures shown in the window of announcement
19.2.2 Site survey in the construction area

There are many different styles of site survey in the construction area, such as residents meetings, individual talks. Consultation forms were distributed for the random selection of the ideas of the citizens who may be affected. Then the different feedback ideas will be collected and accounted and analyzed.

19.3 Survey scope and objects

Three aspects of the public are surveyed:

I People of all circles expressing ideas on the internet

I Managers involved in all the relevant government departments

I The residents in the construction area, including Haixingcun, Haihongcun and Chuanshacun in Luojin town, Hailucun in Yuepu town.

19.4 Object matters of survey

(1) The public’s knowledge of the project, ideas and proposals.

(2) The public’s knowledge of the environment quality in the area, and the knowledge of the public’s environmental ideas.

(3) The public’s knowledge of the environment problems that will occur during the construction and operation and their demands.

(4) The public’s ideas, demands and suggestions about the environment protection during the construction and operation.

19.5 Survey statistics

19.5.1 Announcement of statistics on the internet

(1) The date of statistics

0:00 9/9/2004 (Beijing time) —— 23:59:59 10/12/ 2004 (Beijing time)
(2) Major statistical data

According to statistics, the total number of online consultation visit is 19,523 and the average daily visit people is 574.

There are 113 effective questionnaires.

Fig. 19-3-a Basic information of online consultation publishers

Fig. 19-3-b Basic information of online consultation publishers

19.5.2 Statistics of questionnaires

(1) Number of questionnaires

The total of 50 copies of questionnaires were released in the public opinion survey site, and 46 copies were actually recovered and the recovery rate was 92%.
Pig 19-4 Site consultation meeting for public opinions

(2) The basic situation of the respondents

The results of the statistics indicate that of the participants in the survey, the people aged 31-45 account for 45%; people aged 45-60 account for 40%; people with a college education or higher account for 1/3 of the respondents. Among the people, more than half of the survey are workers and farmers.

19.5.3 Items surveyed and the results

Consultation on the internet and the opinions of the participants at the consultation site, see Table 19-3.
Table 19-3: The statistics of the opinions of the public participants in or around the construction area

<table>
<thead>
<tr>
<th>Items in the survey</th>
<th>Statistical results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge of the construction</strong></td>
<td></td>
</tr>
<tr>
<td>Whether or not you are aware of Pusteel relocation:</td>
<td>Yes (31%) Know slightly (53%) No (16%)</td>
</tr>
<tr>
<td>How do you think this project will affect Shanghai's environment and regional development:</td>
<td>Promote greatly (27%) Promote (47%) Promote slightly (26%) Adverse effect seriously</td>
</tr>
<tr>
<td>Are you in favor of Pusteel's relocation?</td>
<td>Yes (74%) No (16%) Indifferent (10%)</td>
</tr>
<tr>
<td><strong>Knowledge of the environment quality</strong></td>
<td></td>
</tr>
<tr>
<td>What do you think of the air quality of the local area?</td>
<td>Satisfying (22%) So so (53%) unsatisfying (31%)</td>
</tr>
<tr>
<td>Are you satisfied with the surface water in the local area?</td>
<td>Satisfying (14%) So so (55%) unsatisfying (30%)</td>
</tr>
<tr>
<td>Are you satisfied with the sound environment in the local area?</td>
<td>Satisfying (14%) So so (57%) unsatisfying (28%)</td>
</tr>
<tr>
<td>The most serious environment problem in the local area:</td>
<td>Noise (9%) Air pollution (46%) Water pollution (33%) Others (8%)</td>
</tr>
<tr>
<td><strong>Attitude towards the environment impact</strong></td>
<td></td>
</tr>
<tr>
<td>Your attitude towards the impact during the construction:</td>
<td>Understanding (62%) Complain ing (22%) Indifferent (16%)</td>
</tr>
<tr>
<td>The most adverse factor in the area after the completion:</td>
<td>Noise (20%) Air pollution (46%) Water pollution (27%) Others (7%)</td>
</tr>
<tr>
<td>Your attitude towards the impact of the project on the living environment quality :</td>
<td>Yes (18%) No idea (82%)</td>
</tr>
</tbody>
</table>
19.6 Discussion on the first public survey results

19.6.1 To what extent the project construction is known and supported

Most respondents indicate they have known or heard about the construction of project by various means before, this shows that there is influence to a certain extent for various media propaganda on the public. Unfortunately there is still 12% of the public do not know about this project, although some respondents know the name, but further contents and significance of the construction project is not quite understood so that the publicity of relevant departments has to take further efforts. Even so, the support rate of the project reached 74%, clearly it is necessary for most of the public, and for the sincere support of the World Expo. Shanghai. However, there is still 16% of the public do not support the project in the survey.

19.6.2 The views on the environment quality in the area of the project

(1). Of the pollution problems in the area, the main problems some respondents believe are dust and surface water pollution, counting for 46% and 33% respectively. The reflected pollution is the ash yard near the power plant, the dust of the coal storage and transportation process, impacting on the living environment in the area remarkably. The public surveyed are not satisfied with the surface water quality, mainly the quality of the local village-run enterprises, such as the directly discharged waste water deteriorating the river water. Moreover, Haixingcun villagers fetch water from Chenhang reservoir, the rest of the villagers get underground water from the local deep well. These villagers are not satisfied with the quality of the drinkable water, expecting some improvement of the drink water for the sake of health.

(2). The public surveyed expect that the city government will intensify the investment in urban environmental transformation and do practical work for the citizens, so that the state of the environment will improve to some extent. While intensifying the supervision and management of the surrounding enterprises, the relevant departments have to set up a long term system of supervision and management to deal with the focus problem of the plant yard and terminal transport vehicles dusting pollution, and to avoid law enforcement to cope with the regulatory departments of inspection and the imposition of anti-crime blitz with the problem left unsettled phenomenon.
19.6.3 Analysis of the public’s attitudes towards the possible impact during the operation

(1). The public surveyed are worried about the results of pollution after the completion, doubting that the volume of wastewater more than 90%, COD more than 90% and above, oil more than 95%, SO2 more than 65% and dust more than 60% will be reduced after the project operation. They expect Pusteel’s verification and full implementation for the pollution control management is realistic, not fraud.

(2). The public surveyed hope that Pusteel will promise that the relocation in Luojin is not to move the original and serious pollution of the production process but to adopt the advanced clean production processes. The blast furnace steelmaking pollution assembly will have to be controlled strictly; steel rolling production lines of plates, belt, large diameter welding pipe and high value-added steel products production lines can be assembled. The local energy consumption and the pollutant emissions will have to be reduced and the logistics and the traffic will be increased. The cleaner energy will be adopted to ensure that the local ecological environment will not be further damaged, and to reduce dust and sulfur dioxide, and other toxic and harmful gas emissions.

(3). The public surveyed, especially the residents living in Haixingcun and Luojin town, are worried about the environment quality in the area. They are not satisfied with// and they think option should be available.

19.6.4 The respondents’ attitudes towards the moving and allocation that will impact on them

In the survey of the impact on the demolition and removal, most of the respondents welcome the demolition. Most of their houses were built in 1980’s and they are very old after twenty years, and living conditions are relatively poor. They generally expressed the hope that through this demolition and remove, and improve housing conditions, and experienced urban life. But they have at the same time various worries about demolition, particularly those older or poor people. They are afraid that they are unable to adapt to urban life after leaving the original land and depending on everything they have to buy with little pension from the town. Some of the aged are worried that they are unable to adapt very soon to the change of their habits.

The younger of the public surveyed expressed the employment opportunities can be provided.
19.6.5 The employees’ attitudes towards the demolition and removal that will impact on them

According to the previous work survey, most of the enterprises involved in the project are small village enterprises. Some enterprises may take the advantage of this demolition opportunity to conduct an internal product adjustments, and some enterprises hope to be concentrated in the local industrial park. The enterprise employees expressed their concern with their new jobs after demolition and removal.

19.7 Analysis of the reasons that some of the public do not support the project

Based on the first public survey results, the main reasons that some of the public do not support the project are that on one hand, the project after operation will deteriorate the surrounding environment quality, and on the other hand, the public doubt the measures for pollution clean-up in Pusteel are effective.

19.8 The evaluation and recommendations of the first public opinions

(1). The statistics of the respondents shows that the structure of the sample age, education and occupation is distributed reasonably and they are representative.

(2). The problems of all aspects from the public exist and they are concerning with most people’s interests and sensitive issues. The relevant departments in the district and in the city will be warned to pay attention to the issues and to bring out the solutions.

(3). The effectiveness of the measures for pollution control that the public brought will be verified and implemented by the relevant departments. At the same time, the greening in the surrounding areas will be done and the government departments have to enhance the environmental monitoring and environmental law enforcement.

(4). It is recommended that new source of pollution has to be prevented in the project, and clean production will be actively promoted with the environment protection education at the same time.

(5). The reflected problems in the first public survey should be included in the evaluation of the project environmental Impact and the preventive measures for
all the adverse factors should be taken. The results of the evaluation should be
open to the citizens and a second public survey should be conducted and there
will be an effective, reasonable reply to the problems in the first public survey.

19.9 The results of the second survey

19.9.1 The return survey targets and methods

Based on the first participation and the results of the first survey in the Pusteel
project, the targets of the second survey were mainly the respondents who didn’t
support the project, and the survey interview was conducted on the telephone.

19.9.2 The time of the return survey

The time of the return survey is March 5 - March 9, 2005.

19.9.3 The items in the return survey

(1). The main conclusion of the evaluation of the environmental impact in the Pusteel
project introduced to the people surveyed

(2). The implementation of the measures for pollution control in Pusteel project
introduced

19.9.4 The results of the return survey

All of the respondents in the return survey expressed after hearing the evaluation
that the prediction of the environmental impact in the evaluation is basically
credible. According to conclusion of the environment protection evaluation “the
implementation of measures on construction project around sensitive targets
presents little impact in the surrounding area”, the respondents are inclined to
support the project.

The respondents are delighted to accept the pledge of Pusteel that the existing
technology will be changed and the technology of coking clean production
without sintering will be adopted.

As to the implementation of the pollution control measures, the public expressed
that on the basis of enhancing the awareness in Pusteel, the relevant
departments should strengthen supervision means to ensure the pollutants
emission will be up to the standard. As to the residents within the distance for
protection, the construction company should cooperate with the relevant departments to step up the implementation of the relocation.
20 Environmental Management

20.1 Environmental Management

20.1.1 Basis for Environmental Management

While managing the environment, Pusteel should carry out the relevant laws and regulations issued by State and Local government, which including:

"Environmental Protection Law of the People’s Republic of China", which was adopted at the 11th meeting of the Standing Committee of the Seventh National People’s Congress on December 26th, 1989;

"Law of the People's Republic of China on the Prevention and Control of Water Pollution", modified on May 15th, 1996;

"Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution", April, 2000;


"Decisions on Several Issues Concerning Environmental Protection", State No.[1996]31;

"Ratification of Relevant Issues Concerning the Acid Rain Control Zone and SO2 Pollutants Control Zone" State No.5 [1998], which passed on January;

"Regulations on the Administration of Construction Project Environmental Protection", Decree No.253 of the State Council, November, 1998;

"Shanghai Environment Protection Regulations", May, 1995

"Standards of Noise at Boundary of Industrial Enterprises of the People's Republic of China"(GB 12348-90);

"Standards of Environmental Noise of Urban Area of the People's Republic of..."
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

China” (GB3096-96);

“Integrated Wastewater Discharge Standard of Shanghai” (DB31/199-1997);

“Standards for Environmental Quality of Surface Water” (GB-2002)

“Intergrated Emission Standard of Air Pollution of the People’s Republic of China” (GB16297-1996);

“Ambient Air Quality Standard of the People’s Republic of China” (GB3095-1996);

“Regulations of Shanghai Municipality on the Administration of Environmental Hygiene”, which came into effort April 1st, 1992;

“Procedures of Shanghai Municipality on the Administration of Confluent Wastewater Facility”, Promulgated on November 15th, 1993;

“Interim Methods on Collection of Fees for Discharge of Pollutants”, Promulgated by the State Council on February 5th, 1982;

“Procedures of Shanghai Municipality on the Administration of Fees Collection and Penalty for Discharge of Pollutants”, Promulgated on May 11th, 1984;

“Shanghai Drainage Administrative Regulation”, December 19th, 1996.

20.1.2 General Principles of Environmental Management

While carrying out the environmental management, Pusteel should abide by the relevant environmental protection laws and regulations of state and Shanghai Municipality. According to Pusteel’s actual situation, the following basic principles should be applied.

(1) Coordinate development between environmental protection and industrial production

Pusteel should coordinate the development between the environmental protection and production and construction, which should be regarded as the guidelines of its economic work in the enterprise. Pusteel should implant in mind the viewpoint of the unity of immediate and long-term interests, of the interests of the part and those of the whole, and of the interests of production economy and those of environment, and then correctly deal with and adjust its own economic
activity. As a major part of enterprise management, environmental management should run through the whole production process. As an assessment indicator for enterprise’s overall image, the enterprise indicator for environmental management could be brought into enterprise plan for development, which is used to assess simultaneously while being sent; also as the content of the economic responsibility system of enterprise to carry out the examination, it could realize the unity of economic, environmental and social benefits in deed.

(2) Overall Planning, Integrated Control

Bring the environmental protection into the enterprise overall plan, and encourage every department to prevent and to control the environmental pollution from each side. Meanwhile, its environmental protection work should fit the environmental protection plan and target in the region where it is located, and its increasing pollutant load should fit the environmental capacity. Also, in the enterprise development plan, except the special chapters for environmental protection, the environmental protection should be a part of each plan for raw material, production, marketing, after service, advertising, and training. Then, the corresponding implementation step and action plan could be made to ensure the realization of integrated prevention and control of pollution.

(3) Combining prevention with control, let prevention dominate

Controlling pollution shall apply such means and methods as combining prevention with control, letting prevention dominate, combining administration with control, and comprehensive treatment, to gain the best environmental benefit.

(4) Protect the environment with the help of advanced science and technology

The comprehensive utilization resources and energy must be promoted rationally; the three wastes shall be abated to the greatest extent in the production process, by the means of organical integration of control, comprehensive utilization and technological transformation.

(5) Enhance the Awareness of Environmental Protection

Every staff’s awareness of environmental protection must be enhanced, combining professional management with nonprofessional management, improving public participation, and adopting rational advises. Also, it is suggested to intensify the publicity to the surrounding communities and the communication with them.
20.1.3 The Present Situation of Pusteel’s Environmental Management

(1) Institutional Framework

Pusteel consists of a steelwork, a special steel plant, a heavy plate plant, a medium plate plant, a processing center for cutting heavy and medium plate and other branch plants, with 8140 staff presently. The environmental management is charged by deputy directors of Complex and all branches. In the Complex, the Safety and Environmental Protection Department is appointed to implement the environmental management under the full responsibility. Environmental Protection Section and Environmental Monitoring Station are its surbodinate bodies, the former mainly charging daily environmental management (including the normal operation and management of environmental protection equipments, the investigation of pollution situation and the treatment…), the later charging the daily monitoring and analysis of wastewater, exhaust air and noise. In the department, there are 15 people charging environmental protection, of which 5 of them are administrative personnel and 10 are staff. Moreover, in each branch, these is 1 or 2 administrative personnel taking full responsibility of environmental protection, and several staff charging the maintenance of environmental protection equipments.

(2) Management System

A series of rules and regulations concerning environmental protection was made in the plant, mainly including:

I Environmental Supervision Measure on the New Construction Project and Reconstruction Project

It is required to monitor the whole process of new construction project and reconstruction project including every stage as project plan, design, construction, debugging, checking and accepting, and to ensure the system of rewards and penalties. The implementation of this measure effectively promotes the realization of the “three simultaneous” principle.

I Management Measures on the Environmental Protection Equipments

In order to strength the management of operation of environmental protection equipments in the whole company, it is explicitly stated that the equipments for pollution abatement (pollutants include exhaust air, wastewater, waste iron, scruff, noise and vibration) must be managed coordinatively as production equipments; and specifically stated the training to operators, periodic maintenance, repair of equipments and outage accident management; that the operation factor of environmental protection equipment(min 95%) and the standards of emission are brought into the assessment indicator of operation of environmental equipments, assessed by Environmental Monitoring Station periodically.
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

I. Comprehensive Assessment Measures on Environmental Protection Management

According to the major pollution problem, a detailed “Table of Implementing Regulations for Assessment and Marking” was made, which respectively provides specific assessment methods to pollution factors, the approved rate of integrated emission and the management of operation of environmental protection equipments. The assessment factors are mainly standards of emission, the operation factor of environmental equipment, the operation records maintenance and so on. Rewards and punishments will be given in accordance with assessment of each section and individual.

II. Working Regulation of Clean Production Management Committee

The working regulation ensures the structural establishment of clean production management committee (general manager serves as the director of the committee), and states clearly the specific duties of the committee, including the clean protection system and the annual working plan of clean production, the scheduling auditing and the promotion of clean production.

(3) Environmental Protection Projects Accomplished in Recent Years

The main environmental protection projects have being completed in recent years are:

The special steel reconstruction project was completed in 2000; the investments respectively in dust removal facilities, water treatment facilities and noise abatement facilities account for 16.5 million yuan, 2.5 million yuan, and 1.79 million yuan, and another 1 million was used in the landscaping.

In 2003, 15 million yuan was spent to abate the repeated smoke and dust from convertors.

At present, these environmental protection equipments, operating fine, have an effect to alleviate the pollution.

(4) Appraise on the Current Situation of Environmental Management

According to the investigation on the operation of environmental protection, the analysis of pollutants discharging and the public survey made by Pusteel, Pusteel's management on environmental protection improves much. Its organization is rational, work and duties of every department being clear, rules and regulations for environmental protection being board-covered and comparatively detailed. However, there are still some shortcomings, mainly:
It is expected to set up the ISO14001 Environmental Management System as soon as possible.

Pusteel should set up the ISO14001 Environmental Management System as soon as possible that makes the concept and management system of environmental protection thorough to every department, every link of production and every staff, because, in the term of ideas and the operation of management system, there is still a gap between the international ISO14001 Environmental Management System and the existing environmental management system made and used by Pusteel, which is not conductive for enterprise to go on the track of improving and sound progress.

It is expected to strength the concept of clean production.

Pusteel is a long-established enterprise with a history of more than 90 years. Recently, adopting such measures as adjusting product structure, promoting the clean production, eliminating the backward technology in the recent years, Pusteel have had great improvement in the field of wastewater, exhaust air emission and in-plant environment. However, since establishing age far long, much technology and equipments being still comparatively obsolete, mostly have no way to satisfy demands of clean production in the iron and steel industry at present. Pusteel could not reached the average level of some advanced iron and steel enterprises in the homeland, in the field of water consumption, energy consumption and raw material consumption of per one product and water repetition utilization; this not only has aggravated enterprise pollution abatement degree of difficulty and overburdened finance, but also has put more pressure to the environment. Therefore, during the period of Pusteel’s relocation, especially while selecting the project, Pusteel should control the project from the very beginning by advocating clean production technologies, which makes it step onto the road of sustainable development from onto the road of treatment after pollution as before; all of that will foster a new image in the new century.

The control of pollution sources in the plant remains to be improved further.

At present, regarding the waste gas, basically the major discharging source in the production process is under the control effectively, but its non-organized discharging sources still exist, for example, the cupola furnace, adopting electro dedust in two electro fields, collects dust ineffectively, and its non-organized discharge is severe. Therefore, along with the promotion of productive technology, the effective measures for controlling pollution shall be adopted to ensure a decrease to discharge pollutants, and a laxation of the impact to environment.

The strengths of propagation on environmental protection education and of implementation of the environmental protection system remain to be reinforced.

In recent years, Pusteel have already spent much on introducing the advanced production technology and equipment, eliminating the facilities badly polluting
building up the supporting environmental protection facilities for pollution abatement, which play a large role in cutting down the creation and discharging of pollutants. Sophisticated equipment must be fine maintained and operated. Such a large-scale iron and steel enterprise as Pusteel, many links of the technology process in every direction, as entire plant production, supporting facilities, pollution treatment and so on, are connected with environmental protection. The environment will be polluted as long as one of those links is not done well, which requires all the staff have a good awareness of environmental protection. On the basis that the environmental protection has been achieved effectively, Pusteel should reinforce the education and propagation to production and management staff. The effort of assessment and management in economic responsibility system shall be reinforced.

20.1.4 The Content of Environmental Protection in the Project

(1) Environmental Management in the Construction Period

Management, specifically for construction process of project, necessarily are carried out in the following aspect:

- During the period of construction, according to laws and regulations concerning the environmental protection of state and Shanghai Municipality, Pusteel should lay the stress on the examination that if the construction process abides to the “three simultaneous” principle;

- if the measures for preventing and controlling pollution are carried out on schedule at the same time with the beginning of principal part of project; if the construction quality meets the requirements;

- and if the stacking, loading and unloading, and transportation of spoiled rubbish and dust after construction are in progress to regulation.

- The disposition of spoiled rubbish and dust after construction should meet the requirements in the Shanghai Municipality Government Decree No.10 [1992] and No.43 [1995] that management should be enhanced;

- In accordance with the requirements in the Document No.20 [1994] by Shanghai Municipality Government, if the continuous, unimpeded draining off facilities is set up in construction site, slime water--produced during construction--is prohibited to discharge before being precipitated;

- According to the relevant laws and regulations, during the period of construction, all the noise of equipments and facilities should be under the control.

- And the domestic sewage and rubbish should be disposed appropriately.
After the completion of construction, the unit in charge of construction should clear the left dust and rubbish on the site, and the construction unit should be responsible for supervising and examining to ensure that the disposition and clean of dust and rubbish is absolutely done.

(2) Environmental Management in the Operation Period

Environmental management in the operation period should be based on the present Pusteel’s environmental management. Pusteel should reinforce the supervision and clean production management further, and establish the ISO14001 Environmental Management System as soon as possible, which the specific content of management including:

1. Supervise and urge and examine that state policies, laws and regulations and enterprise rules and regulations concerning environmental protection are carried out by every enterprise.

2. Supervise the operation of environmental protection facilities and the pollutants discharge all over the plant. Figure out and understand the pollution situation, make files recorded pollution sources, and monitor environment periodically;

3. Make an program and a plan for enterprise environmental protection, and bring them into the progem and plan for production development as a part of production target.

4. According to the relevant standards of state and Shanghai Municipality, make the indicators of pollutants discharge, of operation of facilities for environmental control, of landscaping and so on, available for assessment with the production indicators, which are conducted to environmental statistics.

5. Jointly organize this enterprise environment scientific research and propagate educational work with institution concerned.

6. Establish and improve various management systems, and frequently examine and supervise them; Build company environment administrative system, and initiate the clean productive technology research, making great efforts to reduce unit cost of energy and product; while developing production, strictly control totality of discharged pollutants; Organize and participate in evaluation and assessment of the environmental protection work, and strictly carry out “the system of rewards and penalties”;

7. Set up the files classifying pollution accidents and the treatment system;

8. Through the environmental education and technology training, the environmental protection awareness and technology level of all administrative personnals and
workers in the company shall be enhanced; and their responsibility for pollution control shall be strengthened, so that they could contribute to beautifying the environment self-consciously, and promote the environmental protection work in the entire plant.

- Strengthen the communication with surrounding communities, and promote the public participation.

- Actively carry out the research on the clean production technology, and make its items and project. Reduce the energy and raw material waste in the process of production that changes the treatment after pollution into the whole production process control.

### 20.2 Environmental Monitoring Plan

**20.2.1 Implementation Standards for Environmental Monitoring**

- "Integrated Wastewater Discharge Standard of Shanghai" (DB31/199-1997);

- "Intergrated Emission Standard of Air Pollution of the People’s Republic of China" (GB16297-1996);

- "Ambient Air Quality Standard of the People’s Republic of China" (GB3095-1996);

- “Standards of Noise at Boundary of Industrial Enterprises of the People’s Republic of China” (GB 12348-90);

**20.2.2 The Present Situation of Pusteel’s Environmental Management**

(1) General Monitoring

At present, according to the characteristics of wastewater and exhaust air outlets, Pusteel adopts the monitoring system shown in the table 20-1.
### Table 20-1: Pusteel Current Situation of Environmental Monitoring

<table>
<thead>
<tr>
<th>Content</th>
<th>Places</th>
<th>Items</th>
<th>Frequency</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wastewater</td>
<td>General Outlet (2 # - 5 # flood control station)</td>
<td>pH, COD, V, Sulphide, SS, CN, F, volatilize phenol, NH&lt;sub&gt;3&lt;/sub&gt;N, Fe, Mn, Ni, Oil, General Cr, Cr&lt;sup&gt;6+&lt;/sup&gt;</td>
<td>6 times per month (2 times per every 10 days)</td>
<td>“Analysis Method on Monitoring Water and Wastewater”</td>
</tr>
<tr>
<td></td>
<td>The steel plant converter -- iron-melting furnace flushing cinder outlet</td>
<td>pH, SS, F</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The steel plant converter -- water treatment outlet of continuous caster desilter</td>
<td>pH, COD, SS, Oi</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outlet of treated water for secondary sedimentation tank of heavy plate rolling steel</td>
<td>pH, COD, SS, Fe, Mn, Ni, Oil, General Cr, Cr&lt;sup&gt;6+&lt;/sup&gt;</td>
<td>3 times per month(once per every 10 days)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outlet of swirl well of medium plate rolling steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outlet of oil separator of cold rolling steel</td>
<td>pH, Fe, Mn, Ni, General Cr, Cr&lt;sup&gt;6+&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outlet of pickling of cold rolling steel</td>
<td>pH, COD, SS, Oi</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outlet of treated water for special steel continuous casting sedimentation tank</td>
<td>pH, COD, SS, Oi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Exhaust air</td>
<td>1# outlet of converter OG system</td>
<td>Smoke and dust in air, cigarette tolerance, velocity, temperature, humidity, oxygen content</td>
<td>Once per month</td>
<td>“Environmental Monitoring Technical Specification” “Environmental Monitoring Technical” Specification</td>
</tr>
<tr>
<td></td>
<td>2# outlet of converter OG system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3# outlet of converter OG system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General outlet of iron-melting furnace for dedusting in east area</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>General outlet of iron-melting furnace for dedusting in west area</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>3# outlet of EAF bag filter</td>
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<tr>
<td></td>
<td>4# outlet of EAF bag filter</td>
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<td></td>
<td>Outlet of LF/AOD EAF bag filte</td>
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<tr>
<td></td>
<td>Entrance of induced fanin east area</td>
<td>Cigarette tolerance, velocity, humidity, temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entrance of induced fanin west area</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

Continued Table 20-1

<table>
<thead>
<tr>
<th>Content</th>
<th>Places</th>
<th>Items</th>
<th>Frequency</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental air</td>
<td>Roof of environmental protection building</td>
<td>NO\textsubscript{x}, SO\textsubscript{2}, TSP</td>
<td>Continuously 24 hours per three months</td>
<td></td>
</tr>
<tr>
<td></td>
<td>First Substation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Fourth flood control station</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Longhua Hospital (south of plant)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roof of 220,000 volts transformer substation (southeast of plant)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Tenth pump station (northwest of plant)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roof of raw material comprehensive building (north of plant)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seventh pump station (central area of plant)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant boundary noise</td>
<td>East plan boundary</td>
<td>Leq (A)</td>
<td>Once per three months, 2 times respectively for daytime and nighttime</td>
<td></td>
</tr>
<tr>
<td></td>
<td>South plan boundary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>West plan boundary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>North plan boundary</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(2) Appraise on the Current Situation of Environmental Management

From monitoring content as said above, Pusteel has built a comparatively integrated environmental monitoring network. The environmental monitoring plan has involved every pollution link in the plant, and the monitoring on the surrounding environment quality. Pusteel also has set up a detailed monitoring management system, being closely connected with the assessment of operation of environmental protection facilities, which offers a powerful monitoring guarantee for discharging standard.

It should be noticed that in the process of environmental monitoring, Pusteel should strengthen the timely analysis to the monitoring result, find out the reason of being beyond the standard, and put forward control plans, which better the practical function of environmental monitoring.

20.2.3 Suggestions on Environmental Monitoring Plan of the Project

According to the engineering analysis, the following environmental monitoring plan are given to deal with the wastewater, exhaust air, equipment noise, ambient air quality and plant boundary noise:

(1) Suggestions on Monitoring Wastewater

Production Wastewater

According to the actual situation of wastewater production in every workshop, it is suggested that water exiting in every set of sewage treatment plant is to be monitored, especially the water entering and exiting in the central treatment station; that the on-line monitoring equipment is to be installed to monitor the displacement and the general factor as COD$_{Cr}$ at real time.

The specific monitoring factors and monitoring frequency to wastewater are expressed in Table 20-2. It is needed to point out that during the period of device pilot run, the monitoring frequency could be higher to a small extent, for adjusting the device according to the monitoring result.

Rainwater

It is suggested that monitor the rainwater outlets after collecting the water on the raw material storage area.

Normalized Setting of Sewage Outlet

20-19
A. Normalized sampling points and discharge sites, easy to measure the rate of flow, should be set up at all the sewage outlets and the workshop sewage outlets discharging the sewage containing with class I pollutants.

B. Normalized sewage outlet should be marked clearly, and be easy to collect samples, to monitor and measure, and to daily manage.

C. The sewage outlet newly set should meet the requirements on current devices as weir and Parshall stated in “Measure Standards for City Drainage Discharge Weir Notch”. According to its industry nature, the quantity of pollutants discharging, and the water body of draining tail water straightly and other principles, the municipal two-stage environmental protection administration authorities decide whether it is need to install flowmeter and online monitoring facilities. It is suggested that monitor the rainwater outlet after collecting the water on the raw material storage area.

(2) Suggestions on Monitoring Exhausted Gas and Ambient Air

I Exhaust air

According to the actual situation of exhausted gas production in each production workshop, it is suggested to monitor the sewage outlet of each exhausted gas treatment device. The specific monitoring factors and monitoring frequency to exhausted gas are expressed in Table 20-2.

I In-plant Atmosphere Environment

In order to improve the pollution control level further, it is suggested to set the ambient air monitoring station around and in the center of the plant. The specific monitoring factors and monitoring frequency are expressed in Table 20-2.

I Requirement on the Setting of Exhausted Gas Sampling Point of Exhaust Mast

A. Sampling Hole

a) Set up the sampling hole on selected sampling location. The inner diameter of sampling hole shall not be smaller than 80 mm, and the pipe range of sampling hole shall be smaller than 50 mm. When not being used, the sampling hole should be covered by cover plate, pipe closer or pipe cap. When only being used for collecting gas pollutants, the inner diameter of sampling hole shall not be smaller than 40 mm.

b) The sealed sampling hole with slide valve shall be used in the gas flue transporting high temperature or toxic gas under the positive pressure.
c) In the circular gas flue, the sampling hole shall be set up in perpendicular diameters that include every measuring point. If the diameter of gas flue is smaller than 0.3 m, only one sampling hole should be set up.

d) In the rectangle or the square gas flue, the sampling hole shall be set up in extension lines that include every measuring point. See Figure 6 & 7. When the cross-sectional area of gas flue is smaller than 0.1 m, the center of cross-sectional area could be selected as the measuring point that could open one monitoring hole in the center of one side, because the distribution of flow regime is comparatively even and symmetrical.

B. Sampling Platform

The sampling platform is set for measuring personnel, and the area must be large enough for working safely and conveniently. The platform area should not be smaller than 1.5 m², with a 1.1 m high guardrail, 1.2 to 1.3 m away from the sampling hole.

(3) Suggestions on Monitoring Wastewater

It is required that construction unit should monitor the noise at the boundary of plant and of major equipments, and then find problems and adopt the measure of prevention and control. The specific monitoring factors and monitoring frequency are expressed in Table 20-2.

(4) Water Consumption Monitoring

It is suggested that construction unit should install a water meter in every workshop and every part of production process that make sure the water balance of the entire plant, which offer the fundamental data for further saving water and reducing the wastewater discharge.

(5) Suggestions on Monitoring Accidents and Contingency Measures

In case of the potential contamination accident as the malfunction of equipments, power cut, raw and supplementary material leakage when loaded and unloaded on the dock, fire and explosion, company should make administrative system and contingency measures, and prepare contingency facilities to monitor the pollution level caused by accidents, and to eliminate pollutants in time, which make the environmental loss lowest.

(6) Public Survey

The public survey should be organized every year to surrounding residents, in
order to find environmental problems in the period of operation in time, and to solve problems faster and more pointedly.

(7) Statistics and Analysis on the Monitoring Datas

Adopting the monitoring plan above, the construction unit should input the monitoring and analysis results into the computer and pigeonhole them. Then by comparing the results with standards and connecting with the result of public survey, the construction unit should analyze the reason of being beyond the standards and put forward the plan for prevention and control.
## Table 20-2  Pusteel’s Environmental Monitoring Plan

<table>
<thead>
<tr>
<th>Content</th>
<th>Pollution Sources</th>
<th>Places</th>
<th>Items</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corex ironmaking</td>
<td>Gas scrubbing water</td>
<td>Exit</td>
<td>pH, SS, CODcr, NH$^3$N, CN’, water discharge amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Granulating slag treatment</td>
<td>Exit</td>
<td>pH, SS, CODcr, water discharge amount</td>
</tr>
<tr>
<td>Wastewater</td>
<td></td>
<td>Shaft furnace</td>
<td>Gas scrubbing water</td>
<td>Exit</td>
</tr>
<tr>
<td></td>
<td>Continuous casting system for steelmaking</td>
<td>gas purifying, directly cooling and flushing wastewater of iron scale</td>
<td>Exit</td>
<td>SS, COD, petroleum oil, water discharge amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steel rolling system</td>
<td>direct cooling water and descaling by high pressure, flushing wastewater of iron scale</td>
<td>Exit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waste acid liquid and wastewater from pickling line (only in steel rolling system)</td>
<td>Exit</td>
<td>pH, total Cr and Cr$^{6+}$, water discharge amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Central wastewater treatment station</td>
<td>Wastewater after preliminary treatment in each manufacturing plant</td>
<td>pH, CODcr, SS, CN’, F, NH$^3$N, Fe, Mn, Ni, Oil, total Cr and Cr$^{6+}$, water discharge amount</td>
</tr>
<tr>
<td></td>
<td>Stock yard</td>
<td>Breaking and screening of raw material, transport of material etc</td>
<td>outlet of the dust collector and surrounding environment of stock yard</td>
<td>Dust, discharge amount of dust</td>
</tr>
<tr>
<td></td>
<td>Corex ironmaking</td>
<td>Coal dry system</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, discharge amount of dust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coal loading system</td>
<td>3 Chimney outlets of bag filter</td>
<td>Dust, discharge amount of dust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Material loading system</td>
<td>2 Chimney outlets of bag filter</td>
<td>Dust, discharge amount of dust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Top charging system</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, discharge amount of dust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fine coal cold briquetting</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, discharge amount of dust</td>
</tr>
<tr>
<td>Domain</td>
<td>Source for collecting dust</td>
<td>Dust, discharge amount of dust</td>
<td>Frequency</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>Gas system</td>
<td>Chimney outlet of wet dust collecting system</td>
<td>Dust, discharge amount of dust</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td>Casthouse</td>
<td>Outlet (chimney flue)</td>
<td>Fume and gas, SO₂, NOₓ, fume flow, velocity, temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pig casting machine</td>
<td>Outlet (chimney)</td>
<td>Fume and gas, dust, CO, SO₂, NOₓ, fume flow, velocity, temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pig casting machine</td>
<td>Outlet (chimney)</td>
<td>Fume and gas, dust, CO, SO₂, NOₓ, fume flow, velocity, temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material loading system</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td>Top charging</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finished products system</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reducing gas heating furnace</td>
<td>General outlet (chimney)</td>
<td>fume and dust, dust, CO, SO₂, NOₓ, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td>Iron dumping station</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molten iron desulphurizing and refining system</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fluoride, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas purifying and recovering systems</td>
<td>Chimney outlet for emitting unqualified gas from converter</td>
<td>Dust, CO, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pouring of molten iron, charging, tapping and converting</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100t DC EAF</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe alloy and auxiliary materials underground storage bin</td>
<td>2 Chimney outlets of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous casting system for steelmaking</td>
<td>Chimney outlet of bag filter</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel rolling system(4200/4200 mm heavy plate workshop)</td>
<td>Chimney outlet (10)</td>
<td>NOₓ, SO₂, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td>Each heating furnace and heat treatment furnace</td>
<td>Chimney outlet of filter element dust collector</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughing mill and finishing mill</td>
<td>Water spraying outlet</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat treatment shot blasting machine</td>
<td>Chimney outlet of filter element dust collector</td>
<td>Dust, fume flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pickling treatment</td>
<td>Purifying tower outlet</td>
<td>NOₓ, F, acid spray, exit air amount</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Activity</td>
<td>Emission源</td>
<td>Emission Parameters</td>
<td>Measurement Frequency</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------</td>
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<td>----------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Each heating furnace and coiler</td>
<td>Chimney outlet</td>
<td>NO\textsubscript{x}, SO\textsubscript{2}, fume flow, velocity, temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>furnace Chimney outlet NO\textsubscript{x}, SO\textsubscript{2}, fume flow, velocity, temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roughing mill Water spraying outlet Dust, fume flow</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Roughing mill Water spraying outlet Dust, fume flow</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hot rolling coil Workshop Chimney outlet of bag filter Dust, fume flow</td>
<td>Once per quarter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transportation and process system for finished products Chimney outlet of bag filter Dust, fume flow</td>
<td>Once per quarter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Lime workshop Lime workshop</td>
<td>Shaft furnace calcinations Chimney outlet of bag filter Dust, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lime workshop Lime workshop</td>
<td>Shaft furnace calcinations Chimney outlet of bag filter Dust, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shaft furnace calcinations Chimney outlet of bag filter Dust, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CCPP generating units</td>
<td>Burning Chimney outlet NO\textsubscript{x}, SO\textsubscript{2}, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CCPP generating units</td>
<td>Burning Chimney outlet NO\textsubscript{x}, SO\textsubscript{2}, fume flow, velocity, temperature</td>
<td>Once per quarter</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Workshop noise Each workshop</td>
<td>All kinds of water pump, fans, air compressor, dispersing mouth of pressure gas, drive system etc. 1 m away from facilities Leq(A)</td>
<td>Once per year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workshops noise</td>
<td>East plant boudary South plant boudary West plant boudary North plant boudary</td>
<td>NO\textsubscript{x}, SO\textsubscript{2}, TSP, CO and falling dust</td>
<td>Once per half year</td>
</tr>
<tr>
<td></td>
<td>East plant boudary South plant boudary West plant boudary North plant boudary</td>
<td>NO\textsubscript{x}, SO\textsubscript{2}, TSP, CO and falling dust</td>
<td>Once per half year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>East plant boudary South plant boudary West plant boudary North plant boudary</td>
<td>NO\textsubscript{x}, SO\textsubscript{2}, TSP, CO and falling dust</td>
<td>Once per half year</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Noise at plant boundary</td>
<td>East plant boudary</td>
<td>Leq (A)</td>
<td>Once per half year, each once in daytime and nighttime</td>
</tr>
<tr>
<td></td>
<td>Noise at plant boundary</td>
<td>East plant boudary</td>
<td>Leq (A)</td>
<td>Once per half year, each once in daytime and nighttime</td>
</tr>
<tr>
<td></td>
<td>Noise at plant boundary</td>
<td>East plant boudary</td>
<td>Leq (A)</td>
<td>Once per half year, each once in daytime and nighttime</td>
</tr>
</tbody>
</table>
When monitoring emissions and ambient air, collect at least four samples every time.
21. Measures to Mitigate Environment Impact

21.1. Purpose

The project of relocating Shanghai Pudong Iron & Steel Co Ltd. Bao Shan Steel Group in Luojing has significant meanings for seriously preparing for and running World Expo 2010 Shanghai, accelerating the development of Shanghai, further enhancing the service level of Shanghai to the whole country as well as all-around construction of a well-off society.

Pudong Iron & Steel company is planned to move to Luojing Baoshan and, together with Baoshan Steel, No 1 Steel and No 5 Steel, form a major steel base with respective features. This is important for increasing the economic radiation of Shanghai, creating a city zone and integrated urban development group with Shanghai as the core, driving the interaction and development among the three economic zone consisted of Jiangsu province, Zhejiang province and Shanghai, in which Shanghai will play a pilot role in economy.

It's a huge project to relocate Pudong Iron & Steel company, for all the farmlands, residents and institutions in Luojing and Yuepu of Baoshan district will be involved. There is a possibility that the society, nature and ecology concerned will be influenced in the early stage of the project as well as in construction and operation periods. In order to decrease the possible negative influence of the project during construction and functioning, this report gives out several feasible mitigation measures to meet the requirements of the environment protection and harmonious developments of society and economy.

21.2. Measures to Mitigate Social and Environment Impacts Prior Construction

21.2.1. Measures to Mitigate the Impact of Land Expropriation on the Farmers

Due to the land expropriation, some people may face re-employment and still other elders may have to retire.

After the arrangement of the farmers with lands being expropriated, the project developer—Shanghai Pudong Iron & Steel, Baoshan Steel Group— would, together with the local government and based on the relevant national law and regulations, provide cultural and re-employment training for the young people poorly educated before, and formulate training plan to have those who have
difficulties to undertake new works to be re-educated, preparing them for new work conditions.

For those who are 55 and 45 years old, male or female, the local governments would have them retired before taking care of them, providing some third industrial works within their abilities for them so that their feeling of loss could be pacified in some way. Meanwhile, in the period of construction and operation, this part of local laborers could also be provided with employment opportunity by employing them.

21.2.2. Measures to Mitigate Impact of Building Demolition

(1) Work out Proper Solutions to Farmhouse Demolition, Compensation and Housing

The developer—Shanghai Pudong Iron & Steel, Baoshan Steel Group—would, together with each local town, to formulate detailed schedules for the farmhouse demolition and re-housing. As per the relevant national and Shanghai municipal laws and regulations, the residents within the demolition area will be informed of the list of the households to be relocated, the demolition conductor, the nature of the project, demolition area, date, policy and plan. The residents would have reasonable compensation because of relocation, or exchange houses according to the same value. Multiple house information will be provided and the relocation work should be done carefully to ensure social stability.

(2) Aid to the Reconstruction of Plants and Other Institutions

In conduction of the project, some schools, plants, enterprises and public institutions will have to relocate or part of their land will be expropriated, causing certain impact on their activities. The project developer would, together with the related departments, formulate a detailed schedule for these units to be relocated, offer economic compensations to the plants and other institutions while helping them to select new sites and providing employment opportunity to them, so that the loss of the plants could be minimized in the project construction.

21.2.3. Measures to Mitigate the Influence of Floating Dust

A great deal of dust would be produced during dismantling, and the air quality will be heavily affected. So, Shanghai Pudong Iron & Steel company has some requirements for the contractor to protect the environment. In the process of dismantling, the contractor is required to (1) stop explosion or dismantling when,
according to the weather report, the wind speed reaches the scale of 5 or above; (2) provide splash or spray when dismantling or exploding, with the exception that the safety of the worker is threatened by the loosing structures because of splashing or spraying; (3) set up cleaning facilities for the vehicles and the supporting facilities, such as waterdrainage and mud-settling pit. The transportation vehicles must be washed and cleaned before leaving the construction site and; (4) take steps to cover or water the construction wastes if they are unable to be moved away within 48 hours, to prevent the construction wastes from floating.

21.2.4. Measures to Mitigate Noise Impact

It is requested that the demolition job should be conducted after 6:00 am and before 10:00 pm.

21.3. Measures to Mitigate Environment Impact during Construction

21.3.1. Measures to Mitigate Impact on Surface Water

Such construction processes as digging and cement injection may produce muddy water with a great deal of suspending substances which, if not treated, would cause turbidity of the water of receiving rivers, or blockage and silt in the sewers. In order to protect receiving water and reduce possible negative influence, the developer should request the contractor to build mud-settling pits for the sewage to settle before the upper layer of clear liquid is drained into the rivers or the sewers of the city, so that the impact of the mud on the rivers could be greatly reduced and the blockage in the sewers of the city prevented. The solid particles in the mud-settling pits should be cleared regularly. The solid wastes and household garbage can be put at the disposal of the environmental department.

During the construction, the domestic sewage from the workers’ mess houses should be filtered off the oil before draining. The droppings should be led into the sewers of the city through septic tanks or drained into the surface water after self-treatment. Approach the local environmental department for the regular clearing of the septic tanks.

Building materials should be placed in an area where a 50cm-high washing-proof wall of rubbles or cements should be built around to prevent the loose materials from being washed away by storm to pollute the surface water.

21.3.2. Measures to Reduce the Floating Dust from the Construction Sites
During the construction and due to the digging of the roads, exposure of the soil, placement of such materials as sands, cements and rubbles, as well as the floating dust caused by the dry wind and the machines, the air quality of the surroundings may be affected. In order to reduce the influence of the construction dusts on the surrounding area, the following requirements should be met:

(1) Set up hard, closed fences around the construction site that are not lower than 2 m.

(2) The ground of the construction site should be hardened.

(3) The construction areas stacked with such dust-producing materials as cements, soil and rubbles should be surrounded with closed fences higher than the bulkload. The dense-hole safety net should be applied outside of the scaffold.

(4) To set up cleaning facilities for the vehicles and supporting facilities such as waterdrainage and mud-settling pit. The transportation vehicles must be washed and cleaned before leaving the construction site.

(5) Corresponding slurry pond and canal should be provided when conducting the construction that will produce a large number of slurry to prevent it from slopping, while the rejected stocks should be moved away by the closed tanker.

(6) For the concrete mixing with capacity above 30m³/day, it is prohibited to carry out outdoors on the spot, while for the capacity below 30m³/day to be conducted outdoors on the spot, dust-prevention measures should be applied. Ready-mix concrete is preferred for the builder.

(7) The use of the air compressor is not allowed for cleaning the vehicles, equipments and stocks.

(8) Closure system should be used to carry loose materials, construction refuses and slag on the buildings and structures. Throwing aloft and scattering are prohibited.

(9) Dust-producing materials should be carried with closed tankers.

(10) The construction refuses and work slag that are unable to be cleared within 48 hours should be placed on a temporary site which is fenced and covered to prevent the dust from floating.
(11) The construction ground should be leveled and the residual soil and bulkload cleared by the builder within 30 days after the construction is completed.

(12) Management of the construction site should be strengthened and civilized working emphasized. When the builder is selected, the environment protection measures should be defined in the contract and see that these measures are implemented through supervision.

21.3.3. Measures to Reduce the Noise of Construction

During the construction, noises may be made by the air compressors, rooters, transportation vehicle horns, engines, excavators and rollers. In order to reduce the influence of the noises on the neighboring residents, the following requirements should be met by the contractor:

(1) Based on the Law of the Peoples Republic of China on the Prevention and Control of Environmental Noise Pollution, to “avoid noise-mading construction works in noise-sensitive, building-concentrated urban area at night.” When, for some special reason that the work has to be going on continuously, it should be approved by the local government of county-level or higher or the relevant department in charge. The builder should, therefore, implement the regulations mentioned above strictly and arrange the works accordingly to minimize the noises of construction.

(2) In compliance with the noise-control requirements by the Noise limits for Construction Site. (GB12523-90), for the works that have to be carried out continuously into night, such as the cast-in-situ bored pile and casting and compacting of concrete, the builder should start earlier and shorten the working time at night, while no fresh pile is allowed at night. Work time should be arranged properly to ensure that the noise made at night meets the requirements. If an overtime night work is needed, the builder has to apply to the local administration—the Department of Environmental Protection of Baoshan, and carry out the construction in designated dates when approved. The residents and units in this area should be informed of in advance.

(3) To set up protective shielding around the construction site, or employ some mobile, simple acoustic shielding between high-noise equipments and noise-sensitive area. The distance between the locations of high-noise works and the noise-sensitive area may be as far as possible. Low-noise-making equipments are preferred. Reduce the noise impact of the equipments on the environment as much as possible. To strengthen traffic control near the construction site, avoid frequent horning when traffic jamming occurs.
(4) To avoid night transportation of rubbish. Transportation vehicle should follow the routes designated by refuse management department to avoid residential areas or, if can’t avoid, to go within the speed limit. For the night transportation of construction refuse and slag, the management of civilized operation should be strengthened. The transportation date, complaint and supervision telephone numbers should be announced while keeping on record of relevant safety station and to be supervised willingly.

(5) To strengthen road and traffic control in the construction period to ensure smooth traffic so that the noises of idle speed and horn reduced.

(6) To work out a noise monitoring plan and strengthen the management of noise monitoring.

21.3.4. Measures to Mitigate the Influence of the Refuse and Solid Wastes of the Site

A lot of engineering spoil and construction refuse may be produced during construction, so the builder should, in compliance with the Shanghai Construction and Engineering Garbage Disposal Regulations (Municipal govt. No. 10. 1992), Circular on Strengthening Management of Construction and Engineering Garbage Disposal of the City (Municipal govt. No.42. 1995) and Opinions on Shanghai Construction and Engineering Garbage Disposal Management—Division Labor of City and District (County)(Draft), declare to the municipal department of refuse management their plan of engineering refuse and construction garbage (including plan of disposal in batches) and sign a document of liability. In case the construction unit or builder shall decide a receiving ground of the refuse and garbage by themselves, the approval certificate of the superior administration of the ground management unit should be presented beside the disposal plan. The builder should, with the disposal certificate approved by the refuse management department, contact transport unit for the shipment formality of the refuse and garbage. The transportation vehicle, when shipping the refuse and garbage, should have the disposal certificate prepared to be checked by the refuse management department, and follow the route designated jointly by the refuse management department, police and traffic control department.

The shipment unit or individual should dump the refuse and garbage to the designated receiving ground and then, have the receipt signed by the ground management unit to be checked by the refuse management division of the shipment unit.
While contacting the refuse management department for the refuse disposal plan and formality, the builder should have management special personnel to conduct on-the-spot management of the refuse and garbage disposal, and fill in the Daily Form of Construction Garbage and Engineering Refuse Disposal accordingly.

Shipment of the refuse and garbage at rush hours should be avoided. The project developer should cooperate with the transportation department to provide professional ethic education for the drivers and, the implementation the plan should be checked randomly.

When some poisonous and harmful refuses are encountered during construction, stop working and contact the local environmental and health departments for solutions before continuing.

Before demolishing the poisonous and harmful building, contact the local environmental and health departments for prevention measures.

A large number of workers will be involved in the construction, so the contractor shall provide provisional accommodation to the workers in a temporary work area. The developer and the contractor should contact the local environmental protection department to get rid of the household refuses timely. The contractor should strengthen the education of the workers in respect of littering to ensure that the work area is clean.

21.3.5. Measures to Mitigate Traffic Impact

During construction, a large number of construction materials are to be shipped into the site while many refuses shipped away. A lot of transportation vehicle will be involved in transporting the materials, among which the land traffic vehicle will be mainly the trucks. The increasing number of the trucks in the urban area will inevitably increase the traffic burden of the area, causing traffic congestion. So, the contractor should, together with the transport and traffic control departments, work out transport routes and time, with effort to avoid rush hours to ensure that the traffic is smooth and the construction could be completed in time. To cooperate with the police in construction period to reduce the impact of the construction on the communication and ensure that the inconvenience brought out by it is controlled to the lowest level.

21.3.6. Measures to Mitigate the Impact on the Cultural Relics and Historical Sites

Although no cultural relics and historical interests are found so far, the builder should stop working immediately in case they are encountered and, report to the
local department of historical relic preservation which will send experts to conduct on-the-spot survey and take evidence before deciding whether the work is to be continued or not. The contractor should provide some knowledge to the workers in this regard.


21.4.1. Measures to Reduce the Influence of Exhaust Gas Emission

(1) Measures to Mitigate the Influence of the Floating Dust from the Stock Yard

For the steel industry, the stock yard is one of the major pollution sources. In China, the watering or spraying liquid containing covering agent is the typical ways to suppress the dust, which is not up to much. It is reported that there is a kind of newly developed covering agent used at home in recent years with better effect achieved in the steel industry. To this end, it is recommended that the builder conduct some investigations at home and abroad on the steel industries with good experiences of dust control and draw lessons from them, so that the feasible measures could be taken to control the environmental pollution by the dust of the stock yard.

In addition, according to the Shanghai Prevention and Management of the Dust Pollution, several requirements regarding the stock yard are given below:

1) Conduct hardening treatment to the ground of the work site.

2) Adopt concrete enclosure wall or canopy storehouse, in which the spraying or other dust-control facilities are applied.

3) Adopt closed transport equipments. Such dust prevention facilities as dust suction and spray should be equipped at the unloading site and see that these equipments are serviceable.

4) Such places dedicated to vehicle cleaning should be prepared at the exit of the stock yard and the washing and cleaning equipments provided.

5) Make a boundary between the stock areas and the roads. Keep the roads clean by clearing the scattering materials and washing the road timely.

(2) Measures to Mitigate the Impact of the Floating Dust from the Stock Yard
After the relocation of Shanghai Pudong Iron & Steel Co Ltd. in Luojing, the production dust or soot dust may be produced in every production process which, if not controlled effectively, would cause severe impact on the environment of this region. Today, the measures of dust-cleaning and dust-falling are often considered when designing the production process, which is expected to put the production dust under effective control. To ensure that each dust-cleaning equipment has the expected result and lifetime, it is recommended that the dust-cleaning equipments should be properly chosen according to their different physical characteristics, while having special personnel to take charge of their maintenance so that they are always serviceable. The equipments should be repaired or replaced in time if any failure occurs and, the dust emission of production should always be in line with the requirement. This will change the bad image of the old Pudong Iron & Steel in terms of dust pollution, and present to the residents of Baoshan with a new appearance of clean and civilized production.

For the dust produced in the process of loading and feeding of the iron ore and pellet ore as well as coaling, the best way is to feed in closed way to reduce or eliminate disorganized emission source and, at the time, transforming them into organized emission source by air pumping and dust cleaning, to keep the dust emission of these sections compliant with the requirements.

(3) Measures to Mitigate the Influence of Poisonous and Harmful Gas

Gas containing fluoride and SO2 gas will be produced in the process of steel making, while the NOx of high consistency and F gas will be produced in the process of the pickling of the stainless steel in the workshop of the heavy steel rolling.

In terms of the SO2 gas produced from burning, it is recommended to use the fuel with low sulfur or desulfurized fuel. A part from reducing SO2 influence on the environment, a lot of sulfur can be recovered from the fuel desulfurization.

For the high concentrated NOx and F gas produced from the heavy plate pickling, measures of intigrated control are planned to ease the influence on the air quality. It is difficult to achieve the expected consistency and rate by the general way of lye absorption due to the high concentration and high emission of NOx. So, it is recommended to control the NOx gas by catalytic reduction. It is more expensive to use this method and higher technique requirement is needed in terms of the reduction temperature and the amount of the reducing agent. So, special personnel should be appointed to take charge of the equipment. The F gas should also be removed while eliminating NOx.
21.4.2. Measures to Mitigate Noise Impact

(1) Employ the Equipments with Lower Noise

Employ the equipments with lower noise, so that the acoustic power could be lowered and the noise controlled from the source. The noise decibels of the lines chosen by this project, such as the electric furnace, rolling line, shear line, sheeting line and heat treating line, as well as such auxiliary equipments as draft fan, high-pressure pump, blower, crusher, compressor-turbine unit, compressor, expansion engine, air compressor and water pump, are from 80dB(A) to 120dB(A). It is, therefore, essential to reduce the noise impact on the environment by choosing the equipments and production lines with the lowest noise dB.

(2) Sound Insulation and Noise Elimination Measures to the Noise Sources

The noise-making equipments are required to be installed indoors, with each equipment provided with sound insulation and noise muffling devices, vibration damper at the base (such as cushion shim and protecting jacket), so that the sound intensity of the machines can be reduced. The workshop should be so designed as to meet the requirement of sound insulation to reduce the noise impact of the equipments on the environment.

(3) Reducing Noise Impact on the External Environment through Proper Layout within the Plant

The maximum noise-control effect could be achieved with the minimum investment through proper layout of the plant. That is to put the equipments and work sections with high noises far away to the boundary, so that the noise influence could be reduced to the lowest because of distance.

21.4.3. Measures to Mitigate the Influence of Sewage

(1) To push on with clean production and reduce the sewage source.

The most economical and effective way to reduce waste water is to reduce the capacity of the sewage from its source. So, Pudong Iron & Steel company should employ clean production technique and reduce the industrial water consumption, while using water as efficiently as possible through water circling and saving, so that the sewage discharge could be under control.

(2) Pretreatment of the Poisonous and Harmful Pollutants
The waste water produced by this project may contain a certain amount of heavy metal and the first-class pollutant. In order that the waste water is drained into the Yangtze River with the pollution index agreed with the fist class requirement, those with heavy metal should be removed of the poisonous and harmful heavy metal before letting into the integrated waste water processing station, so that the discharge standard is met.

### 21.4.4. Measures to Mitigate the Influence of Solid Waste

The solid waste storage sites should be built in the whole plant.

The waste storage and disposal sites should be designed in line with the requirements.

The scruff and steel slag produced in the process of the construction are general industrial solid wastes, and the storage, disposal sites and management of which should be designed strictly in accordance with the Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes. (GB 18599-2001). The chromic mud produced by the sewage of the stainless steel pickling is hazardous waste, and the storage, disposal sites and management of which should be designed strictly in accordance with the Standard for Pollution Control on Hazardous Waste Storage. (GB 18597-2001).

### 21.4.5. Protection Measures to the Ecological Environment

1. Proper Redistribution with Emphasis on Landscaping
2. Integrated Utilization of Exhaust Heat
3. Improvement of the Technique of the Cooling Discharge
4. Strengthening Supervision and Management of the Heat Discharge

### 21.4.6. Measures to Lower the Risk of the Oil Pilling

In order to decrease the influence of the spilling incident on the environment, Pudong Iron & Steel should have emergency reaction procedures to the possible risk, which shall include:

To set up a special emergency department to coordinate rescue job should an accident occur;
To draw up and enforce an emergency plan with respect of the material and equipment provision;

To propose training and exercise plan regarding emergency measures

21.5. **Summery of the Measures to Mitigate Environmental Impact**

All analysis and mitigation measures mentioned above as well as the executors are listed in Table 21-1.
Table 21 Summary of the Measures to Mitigate Environment Impact

<table>
<thead>
<tr>
<th>Items</th>
<th>Possible impacts</th>
<th>Mitigation measures</th>
<th>Executors/Supervision dept.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Prio-construction</td>
<td></td>
</tr>
<tr>
<td>Farmhouses</td>
<td>Impact of relocation on dwelling</td>
<td>To draft a schedule Based on the national &amp; Shanghai laws of relocation to offer: (1) compensation or (2) house exchange of the same value or better</td>
<td>Pudong Iron &amp; Steel/Yuepu, Baoshan and Luojing gov.</td>
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<tr>
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<tr>
<td>Houses for the enterprises &amp;</td>
<td>Relocation, disequilibrium and unemployment</td>
<td>Based on the national &amp; Shanghai laws to offer compensation, relocation or move into Baoshan industrial area</td>
<td>Pudong Iron &amp; Steel/Yuepu, Baoshan and Luojing gov.</td>
</tr>
<tr>
<td>public institutions</td>
<td></td>
<td></td>
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<tr>
<td>Farmland expropriation</td>
<td>Loss of the land</td>
<td>Based on the national &amp; Shanghai laws to provide compensation, pension or insurance</td>
<td>Pudong Iron &amp; Steel/Yuepu, Baoshan and Luojing gov.</td>
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<tr>
<td>Roads</td>
<td>Roads and communication affected</td>
<td>Proper traffic control</td>
<td>Contractor/Police</td>
</tr>
<tr>
<td></td>
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<tr>
<td>construction drainage</td>
<td>Sewers blockage and surface water pollution</td>
<td>Build mud-settling pits</td>
<td>Contractor/Pudong Iron &amp; Steel</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td>Household drainage</td>
<td>Water pollution</td>
<td>Sewage from mess filtered before draining into municipal sewers, use the existing toilets as much as possible</td>
<td>Contractor/Pudong Iron &amp; Steel</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Noise</td>
<td>Annoyance suffered during construction</td>
<td>No fresh pile allowed at night, noise-making equipments far away from sensitive area, noise shielding</td>
<td>Contractor/Pudong Iron &amp; Steel</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>Disposal of surplus refuse</td>
<td>Disposal of surplus refuse</td>
<td>To dispose as per the refuse disposal plan</td>
<td>Contractor/Pudong Iron &amp; Steel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To discard randomly or fill in river, canal and pond not allowed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use the refuse to raise the base of new building or in other works needing the soil for filling</td>
<td>Contractor/Refuse management department of Baoshan, Shanghai</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipment of surplus refuse</td>
<td>Transported by professional transport department with covered special vehicle</td>
<td></td>
<td>Contractor/Pudong Iron &amp; Steel</td>
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</tr>
</tbody>
</table>
**Table 21-1 Summary of the Measures to Mitigate Environment Impact**

<table>
<thead>
<tr>
<th>Items</th>
<th>Possible impacts</th>
<th>Mitigation measures</th>
<th>Executors/Supervision dept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floating dust</td>
<td>Dust produced by refuse or construction materials</td>
<td>Take away the surplus soil immediately, no overnight</td>
<td>Contractor/Pudong Iron &amp; Steel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tires of transport vehicle to be cleaned before leaving</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over loading vehicle not allowed</td>
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<tr>
<td></td>
<td></td>
<td>Tamp the road when filled with the refuse and water it in dry days</td>
<td></td>
</tr>
<tr>
<td>Household refuses</td>
<td>Environmental hygiene is affected</td>
<td>Take them away immediately</td>
<td>Environmental dept./Contractor</td>
</tr>
<tr>
<td>Cultural relics</td>
<td>Undiscovered</td>
<td>Stop working when discovered and report immediately</td>
<td>Contractor/Pudong Iron &amp; Steel</td>
</tr>
<tr>
<td><strong>Operation Period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polluting gas</td>
<td>Dust from stock yards</td>
<td>Ground hardening, canopy, closed transportation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction dust</td>
<td>Eliminate disorganized emission, employ proper dust-cleaning equipments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>poisonous &amp; harmful gas</td>
<td>Adopt proper control method, integrated utilization</td>
<td></td>
</tr>
<tr>
<td>Sewage pollution</td>
<td>Heavy metal and first-class pollutant</td>
<td>Pretreatment to meet standard before further treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discharge capacity</td>
<td>water saving, circling, standard discharge</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Noise by equipments</td>
<td>employ low noise equipments</td>
<td>Pudong Iron &amp; Steel</td>
</tr>
<tr>
<td></td>
<td>Sound insulation, vibration damper and noise reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise from plant area</td>
<td>Proper distribution, put high-noise equipments as far as possible</td>
<td></td>
</tr>
<tr>
<td>Solid wastes</td>
<td>Surrounding soil and surface water affected</td>
<td>Sorted collection and storage; hazardous wastes to be disposed of by qualified unit</td>
<td></td>
</tr>
<tr>
<td>Ecology</td>
<td>Hydrobiology is influenced</td>
<td>Strengthening supervision of hot water discharge, improving cooling discharge technique</td>
<td></td>
</tr>
<tr>
<td>Spilling incident</td>
<td>Accident risk</td>
<td>Set up emergency control system</td>
<td></td>
</tr>
<tr>
<td>Pollution discharge and impact</td>
<td></td>
<td>Set up environmental department and environmental protection system</td>
<td></td>
</tr>
</tbody>
</table>
22 Environmental Impact Assessment of Dock Construction

22.1 Finished Products Pier Project

22.1.1 General Situation of the Project

The finished products pier is to be located at the upriver of the pier for raw material, near the product output area of Luojing plant. Its throughput was designed to be 3.09 million ton for the first step, 4.81 million ton for the second. The pier was disposed as a reverse "L", which dimension is 355m*55m. There are 4 tracks for bridge transporter, each 16m apart, and the width and length of bridge approach are respectively 15m and 1100m. Ships of 5000 ton and of 10000 ton could dock respectively inside and outside (two berths for inside and outside). Behind the pier, there is a storage area for finished products, occupying 112 thousand m$^2$.

The road, for relieving the dock load and transporting goods between the pier and the plant, is planned to build out of the plant, to be a ring road with the existing Beiyunchuan Road in the port area.

Major equipments for loading and unloading goods are shown as following. Shore bridge transporters amount to 5 for the first step and 8 for the second; tractors of 4.5 ton amount to 8 for the first step and 12 for the second; flat cars of 40 ton amount to 24 for the first step and 36 for the second, and ones of 50 ton amount to 8 for the first step and 12 for the second; wheel cranes of 25 ton amount to 4 for the first step and 6 for the second; fork trucks of 40 ton amount to 4 for the first step and 6 for the second.

The tasks of this pier are that output finished heavy plates of 4200mm produced from rolling mill workshops, steel coil and finished heavy and medium plates.

If a transport ship docks in the Yangtze River, its berth is dispatched and arranged unifiedly by Shanghai harbor departments.

22.1.2 Identification of Environmental Impact

See Table 22.1-1 showing the major environmental impact on the construction of finished products pier.
Table 22.1-1 Major Environmental Impact on the Construction

<table>
<thead>
<tr>
<th>Stage</th>
<th>Action</th>
<th>Environmental Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Period</td>
<td>Dredging and Desilting</td>
<td>Increase the concentration of the suspended particulate in river water, destroy the living environment for river benthos, and harm the plankton and fish in the river.</td>
</tr>
<tr>
<td></td>
<td>Construction Ship</td>
<td>Produce ship sewage, fuel, waste gas and noise.</td>
</tr>
<tr>
<td></td>
<td>Pier construction</td>
<td>The domestic sewage and garbage produced by workers, waste gas and noise produced by equipments and vehicles in construction, the contaminated water, air and acoustic environment in the area of construction</td>
</tr>
<tr>
<td>Operation Period</td>
<td>Cargo Work</td>
<td>Waste gas and noise produced when doing cargo work, and when freight cars coming in and out</td>
</tr>
<tr>
<td></td>
<td>Maintenance of Vessels</td>
<td>The waters contaminated by production waste water, as oily waste water, from the workshop of repairing equipments</td>
</tr>
<tr>
<td></td>
<td>and Equipments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ships Entering</td>
<td>Waste gas, rubbish and noise from ships, and spilling accident risk</td>
</tr>
<tr>
<td></td>
<td>and Leaving the Port</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and Docking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Production Staff’s</td>
<td>Domestic sewage and garbage</td>
</tr>
<tr>
<td></td>
<td>Activities</td>
<td></td>
</tr>
</tbody>
</table>

22.1.3 Estimation of Pollution Sources and Pollutants

22.1.3.1 Construction Period

During the production period, the major pollutants of this project are the suspended matter produced when dredging the harbor, the waste water and noise of construction (including noise from equipments’ operation and transportation), the floating dust, the waste gas and solid wastes produced by equipments and vehicles.

(1). Harbor dredging and desilting

The front line of finished products pier is located at the place with natural depth of 10 m, with a small siltation volume. Referring to the outcome in “Analysis on the River Regime Evolution, Plane 2-D Current Numerical Model and Sedimentation of Luojing Port Construction Phase II of Shanghai Harbor” (Construction Phase II is near the finished products pier) compiled by Southern Water Conservancy and Science Institute, the annual intensity of sedimentation is 1.2 m ~ 1.5 m per year around, and the annual total amount of maintenance dredging is about 1.35 million m³, in the Luojing Port Construction, Phase II.
According to pier lengths by analogizing, the annual total amount of maintenance dredging is 234,000 m$^3$ in the finished products pier.

During the process of dredging, the agitation of reamer not only makes the sediment suspended that the water body becomes muddy and that the quality of water is reduced; but also destroy the living environment of benthos in the area of sand-fetching and dredging, and harm the plankton. The main pollutant is SS. According to the result from a field simulation test of the emission source intensity when cutter-suction dredge operating in Tianjing Harbor (self-propelled cutter-suction dredges of 1500m$^3$/hr used in the test), made by Tianjin Institute of Water Transport Engineering, the average concentration of vertical distribution of suspended sediment is about 700~1000mg/l in the center area of operation.

(2). Estimation of the dust pollution source intensity at the construction site of port

As construction on the port is usually multi-pointed, point sources and non-point sources effect the air environment together. In order to correctly analyze the impact of harbor construction on the outer environment, it is scientific to treat the construction site as a non-point source. Comparing to the research on dust pollution rule at the construction site of Tianjing Harbor, the pollution source intensity of its non-point source is 539000mg/s.km$^2$ without the implement of measures on environmental protection; and the pollution source intensity of its non-point source is 140000mg/s.km$^2$ without the implement of measures. Both happen under the joint function of fugitive dust caused by wind erosion from stock yard, dust pollution when trucks unloading material, second fugitive dust on the road, dust pollution when opening the pack of cement, fugitive dust at the site and other factors. With the implementation the environmental protection measures, the pollution source intensity of non-point source is 140000 mg/s.km$^2$ in the site.

(3). Intensity of Noise Source

This project is following the regular construction methods. In the construction period, the impact on the sound environment is mainly the noise of equipment on operation. The major noise sources of equipments are shown in Table 22.1-2.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Major Noise Sources</th>
<th>Noise level</th>
<th>Monitoring distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth-rock</td>
<td>Bulldozer, grab, reversed loader...</td>
<td>78</td>
<td>10</td>
</tr>
<tr>
<td>Fundamental Treatment</td>
<td>All kinds of pile drivers</td>
<td>82</td>
<td>30</td>
</tr>
</tbody>
</table>
(4). the Quantity of Waste Water in the Construction Period

According to the analogy research, the waste water in the construction period is mainly the domestic sewage of workers, amount to 10~15 m$^3$/d approximately.

22.1.3.2 Operation Period

(1). Technological Process and Pollutants Discharging Node

Technological process and pollutants discharging node in the finished products pier are shown in the table.

![Diagram of technological process and pollutants discharging node]

Table 22.1-1 Technological Process and Pollutants Discharging Node in the Finished Products Pier

Cargo technology and pollutants discharging node in the finished products pier, and pollution factors are shown in the Table 22.1-3.

Table 22.1-3 Cargo Technology and Pollutants Discharging Node in the Finished Products Pier, and Pollution Factors

<table>
<thead>
<tr>
<th>Pollutants Discharging Node</th>
<th>Pollution Factors(Pollutants Class)</th>
<th>The Technological Stage of Pollutants Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>$W_1$</td>
<td>COD, BOD, NH$_3$, N, Oil</td>
<td>Oily waste water from engine room of ships, and sewage from sailors</td>
</tr>
<tr>
<td>$W_2$</td>
<td>SS</td>
<td>Dust from stock yards</td>
</tr>
<tr>
<td>$G_1$</td>
<td>SO$_2$, dust</td>
<td>Waste gas produced by burning diesel oil from ships and vehicles, and fugitive dust produced in the cargo work</td>
</tr>
<tr>
<td>$G_2$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

<table>
<thead>
<tr>
<th>N₁</th>
<th>Noise</th>
<th>Ships</th>
</tr>
</thead>
<tbody>
<tr>
<td>N₂, N₃, N₄, N₅</td>
<td>Exhausted Gas</td>
<td>Equipments for cargo work, and freight cars</td>
</tr>
<tr>
<td>S₁</td>
<td>Solid Waste</td>
<td>Rubbish from ships</td>
</tr>
<tr>
<td>S₂</td>
<td>Solid Waste</td>
<td>Rubbish on the road of stock area</td>
</tr>
</tbody>
</table>

(2). Estimation of the Discharge of Pollutants

I Exhausted Gas

The finished products pier is mainly used for the output of large finished iron and steel goods, and the input of waste iron, and carrying out the water dreg. When loading and unloading the ware dregs on the pier, dust is seldom produced, because the water dreg is comparatively large and highly in water content.

SO₂ and fume and dust produced by burning diesel oil from docking ships and transportation vehicles. According to the “Report on Environmental Impact of Luojing Harbor Construction Phase II, in Shanghai Harbor”, comparing to the condition of loading and unloading the goods with same weight, SO₂ and dust are 0.72 kg/h and 0.08 kg/h, discharged by docking ships and transportation vehicles in the second step of this project.

I Sewage pollution

The largest daily water consumption of this pier is about 660m³/d, in which 600 m³ is for ships, and 60 m³ for production and living on the pier.

It is estimated that, on the pier, the largest production of oily waste water is 10m³/d, produced by washing the machines from the workshop for repairing equipments in the production supporting area; and the largest production of domestic sewage is 20m³/d, produced from the buildings in the production supporting area.

I Solid wastes

The solid wastes on the pier are mainly production refuse and garbage, and the rubbish from ships.

I Noise

The noise in the port is mainly produced by equipments for cargo work and supporting equipments, vehicles and ships on operation.

Table 22.1-4 Noise Level of Equipments for Cargo Work and Transportation Vehicles in Operation

22-5
<table>
<thead>
<tr>
<th>Name</th>
<th>Noise Level dB(A)</th>
<th>Name</th>
<th>Noise Level dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quay Side Container Crane</td>
<td>67—85</td>
<td>Flat Car</td>
<td>90—96</td>
</tr>
<tr>
<td>Tractor</td>
<td>75—90</td>
<td>Fork Truck</td>
<td>80—90</td>
</tr>
<tr>
<td>Wheel Crane</td>
<td>67—88</td>
<td>When ships berthing</td>
<td>70-75</td>
</tr>
</tbody>
</table>

(3). Measures on Controlling Pollution

The finished products pier does not affect the local atmosphere environment seriously, because it is located at the shore of Yangtze River in the north of the plate, being close to the main channel of Yangtze River, and far away from shores.

The oily sewage produced by the facilities for repairing equipments, is collected into production area in the plate, and then treated with the oily waste water together. The sewage from living is planned to be send to the Shidongkou Wastewater Treatment Plant through the sewers in the plant. A docking ship should be installed a oily water separator, and ensure its operation. The sewage from ships is collected and treated by the department of maritime affairs. It is not allowed to discharge such matters into Yangtze River, as oily waste water and sewage from ships, and oily waste water produce when repairing equipments, and sewage from buildings.

When making the planar design of pier in the area of port, roads, and the lay and positions of equipments for harbor work should be properly arranged; honking is limited, only the product of low-noise, low-consumption could be used in equipments for harbor work.

Being prohibited to discharge to the surrounding waters, the garbage from ships should be collected and dealt with by the Sanitation Department; dustbins should be available on the pier for timely collecting garbage, which is cleaned with garbage in the entire plate by Sanitation Department.

As shown from the analysis of the pollution sources, the emission of exhaust gas is basically belonged to the non-pot source, and the source strength is not high, and the discharge volume is relatively lower. In view of the entire Pusteel relocation project, impact of the finished products pier on the environment are mainly the impact on the water quality and aquatic organisms in Yangtze River that is the SS produced by dredging and desilting during the construction, and the impact of oil spilling on the Chenhang Reservoir resulting from ships collision on the port.
22.2 Impact on the Water Quality and Aquatic Organisms

22.2.1 Analysis of impact on the water quality resulting from the dredging

During the period of construction, the dredging will be carried out by 1500m$^3$ cutter-suction dredger. Shown from the analysis result, the dredging operation will bring the suspended matters pollution to the water body. The average level of vertical suspended sediment in the central operation area of cutter-suction dredger is about 700 to 1000mg/l, and the maximum amount of increment to the water body of Yangtze River outside the central operation area is about 300 to 500mg/l, and the farthest affected area can reach 5km on the upstream and 8km for the downstream, the maximum contributive level to the intake of Chenhang Reservoir can reach 100mg/l. The water in the Chenhang Reservoir stays in the reservoir for 7 to 10 days, and there is enough time for precipitation of the suspended matters, and so the increase in the level of suspended solids on the water quality is not greatly affected. With the end of construction, the water quality can restore the current background level.

22.2.2 Analysis of impact on the aquatic organisms

(1). Analysis of the impact on the aquatic organisms due to the increases in the suspended solids in the construction water field

During the harbor dredging process, the operation of cutter-suction dredger will result in a substantial increase of suspended solids in the construction water field, and cause the muddy water in the local waters, which would decline the sunlight transmission rate, and makes the biological waters move to elsewhere, and the plankton will be affected to different degree. Especially, the filter-feeding zooplankton and phytoplankton with photosynthesis will be affected greatly, this is mainly due to the construction work caused water to the increase in suspended solids, suspended particles will adhere to the animal skin, interfere with the normal physiological function. Filter-feeding zooplankton and fish will devour the suspended particles with appropriate particle size and cause the internal digestive disorder. In addition, the decline in water transparency and the dissolved oxygen in waters will bring a negative impact on the photosynthesis of phytoplankton, and on turn impede the phytoplankton cell division and growth, lowering the unit phytoplankton in the water body volume, result in the primary productivity in the waters decline.

The decline in primary productivity will make the phytoplankton biomass declined. In the aquatic food chain, in addition to the primary producers-planktonic algae, other nutrition level is the biological as well as consumers on nutritional level biological bait. Therefore, the phytoplankton biomass reduction makes food for phytoplankton to zooplankton in the water unit owned by the biomass to decline accordingly. So these zooplankton that feed on the fish, due to the lack of food and resources decline. However, predatory fish living in a number of senior
consumers will be as low nutrient level of the reduction of the number of biological, and difficult to feed. It is obvious that the content of suspended substances in water is increased, the impact on the entire water main ecological food chain is multi-linkage.

The second is the impact of the zooplankton. According to the related information, the content of suspended substances in the water is increased, the planktonic copepods animal survival and reproduction is significantly inhibited. Excessive amount of suspended material will plug the planktonic copepods animal food filtration system and the digestive system. Especially in their concentration levels up to 300 mg/l and above, the harm is particularly evident. In the suspended material, the harm of viscous mud is the most, and the earth and sand mud takes the second place. Meanwhile, the excessive levels of suspended material will significantly inhibit the survival of fish, shrimp larvae.

(2). Impact analysis on the benthic organisms

In this construction, since the port dredging construction operations, changes in the biological environment of the original habitat. In particular, the impact of benthic organisms is the greatest. During the construction period, the quality of the bottom environment of the waters will be completely changed, that will allow a small number of benthic species with strong activities capacity fled to other place, most of the benthic species will be buried and covered with the exception of a few to survive, the majority will die. The engineering on the local benthic organisms is very destructive. The benthonic organisms in Yangtze River estuary have been damaged for years, they have been in the situation difficult to restore.

(3). Analysis of impact on the fishery resources

The waters near the engineering are also the routes of major economic migratory fish and spawning area. However, according to the ecological environment monitoring results, 1998-2003 for the deep channel engineering, Phase I & II of Yangtze River Estuary, in Yangtze Delta fisheries resources, the several investigations factors such as knife Anchovy, Fung Anchovy, mitten crab, and eel, knife Anchovy, Fung Anchovy, eel has been changed markedly. Although the change in fishery resource can not be due to a project, but as one of the reasons, the project also contributed to the decline of fisheries resources. Therefore, the implementation of the pier project will affect the fisheries resources, so the effective ecological measures shall be taken to mitigate its biological resources at Yangtze River Estuary as far as possible.
22.3 Risk Assessment of Oil Spills in Finished Products Pier

22.3.1 Risk identification

22.3.1.1 Risk characteristics of fuel oil

As a petrochemical product, the fuel oil is a complex liquid mixture which is mainly composed of the hydrocarbon compositions, also contains a small amount of oxygen, nitrogen, sulfur and other compounds have the following main characteristics:

a). Flammability: most of products have lower flash point, and the flash point is closed to the ignition point.

b). Explosive nature: petrochemical products, especially for the light oil products, their temperature and energy required for ignition is relatively lower, in the case of certain concentration of the gas explosion is reached, are prone to explosion.

c). Easy accumulation of electrostatic charges: the conductivity of the petrochemical products are generally lower, i.e. their electrical resistivity is higher, also it is non-electrostatic conductor, and easy to accumulated charge, and not easy to disperse.

d). Easy-evaporation, easy-proliferation, and easy-run off: Major components, such as hydrocarbon molecules are very easily evaporated and diffused; Petroleum is easily dispersed along the ground surface, and liquid is easily run off along the ground surface or waters.

e). Easy-boil over: in case of the heavy petroleum products or water-containing petroleum products are burned, the sudden boiling over may occurs - splash to the outside containers.

f). Easy to thermal expansion: in case of the oil products are heated, the temperature is raised and the volume is expanded, and easy resulting in containers and tube defects; in case of the temperature is lowered, the volume is shrinked, and negative pressure in containers will occur, and resulting in the containers deformation and damage.

g). Toxicity: the toxicity of the petroleum and its products are function of the dissolved aromatics. The C10 to C17 aromatics in the fuel is much higher than of in crude oil, so the toxicity of the fuel is higher than the crude oil.
22.3.1.2 Analysis of potential accidents occur during operation

The ships on finished products pier of the project may occur the following types of incidents:

a). Leaking oil spills incidents

The external influences or defects on equipment, and personal factors may cause fuel compartment ruptured, and cause oil spills.

b). Oil-proliferation

In case of the oil spills, they will proliferate in the atomosphere, water and ground, and may result in injury to persons and environmental pollution. Among which, the possibility of direct leakage into the water is the most likely, and the influential range is most widely.

22.3.2 Accident investigation and analysis

22.3.2.1 The accident investigation

According to the statistics on the major oil spill off records for Yangtze River and Huangpu River by Shanghai Maritime Bureau, 1978-1999, the large oil spills occurred in 23 cases, and one case had no record of oil volume, the annual average level is one case occurred, among which 15 cases occurred in waters of the Huangpu River, and 8 cases occurred in the Yangtze River waters. For details, see Table 22.3-1.

As shown in Table 22.3-1, the accidents occurred due to collision accounted for 60% of the total. Such incidents are generally due to the failure of navigation equipment on board, or due to the bad natural conditions, which also includes some of the operational misconduct or mismanagement. In addition, some oil spills occurred is due to operational errors, this is mainly due to the mis-operation of handling staff, such as the failed inspection prior to the operation, not timely transferring the ship cabin, no shutdown the pumps timely after finishing the oil supplying or in case of incidents occurred.

According to Table 22.3-1, among the statistics for pollution incidents for more than 10 tons of oil pollution, there are 18 accidents with oil spills more than 10 tons, among which 13 accidents were caused by marine accidents, accounting for 72%; 6 accidents with oil spills over 100 tons, among which 5 accidents were caused by marine accidents, accounting for 88%. These accidents caused by collisions accounted for 44%. What should not be overlooked are the tanker
collisions, groundings of the marine accidents, they appear with upward trend, and bring serious pollution risks to the port.

Table 22.3-1 Major oil spill off record for Shanghai Yangtze River and Huangpu River (1978-1999)

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Place</th>
<th>Ship name or unit</th>
<th>Reason</th>
<th>Oil spill off volume (t)</th>
<th>Types</th>
<th>Elimination or recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1978.1.8</td>
<td>Coastal oil terminal</td>
<td>Sea Oil 21</td>
<td>Mis-operation</td>
<td>27</td>
<td>Enes oil</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1978.1.9</td>
<td>Outside Yangtze River estuary</td>
<td>Athens Horizons</td>
<td>Damaged hull</td>
<td>1400</td>
<td>Bean oil</td>
<td>Fewer</td>
</tr>
<tr>
<td>3</td>
<td>1978.4.2</td>
<td>Gaoqiao oil station</td>
<td>Daqing 412</td>
<td>Oil unloading valve not closed</td>
<td>655</td>
<td>Light diesel oil</td>
<td>330</td>
</tr>
<tr>
<td>4</td>
<td>1978.8.7</td>
<td>Sewer of Shanghai Refinery</td>
<td>Shanghai Refinery</td>
<td>Distiller leakage</td>
<td>100</td>
<td>Semi-product</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1979.1.8</td>
<td>Gaoqiao oil station</td>
<td>TomLudan</td>
<td>Automatic valve malfunction</td>
<td>7.2</td>
<td>Gasoline</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>1982.6.1</td>
<td>Shanghai Refinery</td>
<td>Daqing 41</td>
<td>Pipeline disconnected</td>
<td>12</td>
<td>Crude oil</td>
<td>Most portion</td>
</tr>
<tr>
<td>7</td>
<td>1983.12.5</td>
<td>Quarantine anchorage</td>
<td>NAMU Lake/border</td>
<td>Oil leakage after collision</td>
<td>15</td>
<td>Fuel oil</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>1985.7.2</td>
<td>B4-5</td>
<td>Sword 927</td>
<td>Zhong Shan Ship damaged</td>
<td>32.7</td>
<td>Fuel oil</td>
<td>Fewer</td>
</tr>
<tr>
<td>9</td>
<td>1985.11.14</td>
<td>B36 Pudong sea-route</td>
<td>Shanghai Gold Oil 103</td>
<td>Oil leakage after collision</td>
<td>10</td>
<td>Oil</td>
<td>Portion</td>
</tr>
<tr>
<td>10</td>
<td>1986.8.1</td>
<td>Oil company terminal</td>
<td>Qingxing Ship</td>
<td>Oil leakage after collision</td>
<td>50</td>
<td>Chinese wood oil</td>
<td>Fewer</td>
</tr>
<tr>
<td>11</td>
<td>1989.8.2</td>
<td>Waters nearby Shanghai Refinery</td>
<td>Wujing 319 Ship</td>
<td>Collision and sink</td>
<td>64</td>
<td>Rubber</td>
<td>Fewer</td>
</tr>
<tr>
<td>12</td>
<td>1989.11.17</td>
<td>Near #107 floating light</td>
<td>Dongyou 606 Ship</td>
<td>Oil leakage after collision</td>
<td>11</td>
<td>Light diesel oil</td>
<td>Portion</td>
</tr>
<tr>
<td>13</td>
<td>1991.3.7</td>
<td>Lifeng Shipyard</td>
<td>Weidehai</td>
<td>Oil leakage</td>
<td>10</td>
<td>Light diesel oil</td>
<td>Most portion</td>
</tr>
<tr>
<td>14</td>
<td>1991.1.8</td>
<td>Chen Tang Vessel 5#</td>
<td>Zhechang Oil 116</td>
<td>Self-sank</td>
<td></td>
<td>Light diesel oil</td>
<td>Most portion</td>
</tr>
<tr>
<td>15</td>
<td>1992.4.2</td>
<td>109 Floating light</td>
<td>Hu Hang Oil 18</td>
<td>Self-sank</td>
<td>23</td>
<td>Light diesel oil</td>
<td>Most portion</td>
</tr>
</tbody>
</table>
22.3.2.2 Analysis of accident cause

Through the statistical analysis and in-depth studies on large number of accidents, we can find the accidents are due to the following reasons:

a). Fuel factor

The physical and chemical property of the fuel, such as volatility, easy to run off, combustible, explosive, toxic, etc. constitute the factors of insecurity.

b). Equipment and facilities factors

Incomplete facilities, inferior quality and improper position are a hidden danger causing accidents.

c). Personal factors

The influences of personal factors will impact the entire process, through design, construction, test and acceptance, use, maintenance, management of the whole project, and therefore, the personal factors in a number of factors account for a very important position.

d). Environmental factors
The entire system is in a certain environment and the surrounding environment influence each other. The environment factors affecting safety are climate, geography and other natural factors.

e). Management factors

The management factors are those by which people, goods, facilities in the environment can be coordinated and organized effectively. Establishing rules and regulations to implement management organizations, complete safety, strengthen legal education, clear security responsibilities are effective management approach.

22.3.3 Accidents affect forecast and analysis

22.3.3.1 Accident source intensity

There are 8 major incidents occurred on the Yangtze River during 22 years, the location of most of them are near the floating lights and anchorage, not in the terminal handling process and near Chenhang Reservoir, that is, not in LUOJING Ferry Terminal, Pier Baosteel, Waigaoqiao port. Among the eight accidents, five accidents belong to the oil transportation, and other three accidents belong to the leakage after the collision. Therefore, the incident source intensity of Pusteel finished products pier will be calculated as 20 tons of fuel leakage per time, of which 50% or 10 tons can be recovered by the emergency treatment, the another 10 tons will be proliferated with the water flow and the leakage point is at the pier. The dominating wind direction is SE, and the annual wind speed is 3.4m/s.

22.3.3.2 Change process of spills in waters

Oil spilled into a body of water, due to various environmental parameters (such as temperature, salinity, light, wind, waves, particles, location and chemical composition of the oil itself), will be complex physical, chemical and biological processes, such as proliferation, drift, evaporation and dispersion, emulsification, photochemical oxidation, sedimentation and biological degradation.

a). Oil spill spreading

The proliferation of oil occurs horizontally with the help of combined action of gravity, the surface tension, and viscosity. At first, gravity plays a major role; when the film thickness is significantly reduced, the surface tension will exceed the role of gravity, lead to the spread of oil spill as a major factor; when the film of oil spill spreading is formed on the water surface, the further proliferation relies mainly on the role of the turbulent sea.
b). Oil spill drift

The film movement acted by the wind and current is known as drift. The water flow can be simulated by mathematical model, but the wind data at the oil spill site is difficult to obtain, so the numerical simulation will bring certain difficulties.

c). Evaporation of oil spill

The evaporation of volatile component of spills can lead to the change in the characteristics of oil spill. After the evaporation, the density and viscosity of the oil on the water surface will increase. The evaporation enable a decrease in oil spills, but also affect the proliferation and emulsifying effect. The main factors affecting the evaporation: the composition, film thickness, temperature, wind speed, and sea condition, etc.

d). Dissolving of oil spills

The dissolution of oil is a natural mixing process dispersing hydrocarbons with low molecular weight to waters. The dissolution rate depends on the oil molecular structure, the proliferation degree, water temperature, turbulence and dispersion degree. The dissolution capacity of heavy fuel oil is relatively poor.

e). Emulsified oil spill

Many oils easily absorb water to form water-in-oil emulsion, and the volume will increase by 3-4 times. This emulsion is usually very sticky, and not easy to disperse. Emulsified oil depends on the content of asphaltene. In the case the content of asphaltene is greater than 0.5%, it is easy to form the stable emulsion; the oil with the asphaltene content smaller than this value will be easily dispersible. Oil emulsion in the marine environment is very difficult to disappear naturally; if it is allowed to drift, in the case of they encounter solid material or the beaches, they will adhere to and the environmental pollution is very difficult to eliminate.

f). Biodegradation of oil spill

The biodegradation is the most fundamental way for the marine environment to be purified. The factors to impact the biodegradation are temperature, oxygen content and the content of nutrients such as nitrogen and phosphorus. The biodegradation rate is relatively low, and can't play a big role to eliminate surface spills for a short period of time. But in view of the pollution of the marine environment, even if it will take months or even years to enable it to resume, and the meanings are very great.

g). Oxidation
The action between petroleum hydrocarbon molecules and oxygen either decompose them to a soluble material or combines them to the persistent tar. However, oil oxidation rate is relatively slow, especially high-viscosity, thick oil or water - in-oil emulsion of very slow oxidation; Comparing with all other changes, and oil oxidation is negligible.

h). Sedimentation

Oil spill, after evaporation, emulsification, and other changes in water, increase its density; and some heavy oil, their relative densities being greater than 1, sink in freshwater or brackish water. The water in shallow water and river estuaries is always mixed with a lot of suspended particles that promotes the oil spill settlement.

22.3.3.3 Principles and Method of Numerical Simulation of Oil Spill

(1). Convection - Diffusion Equation

By adopting a depth-averaged and two-dimensional quality transfer model, the governing equation is written as:

\[
\frac{\partial (Ch)}{\partial t} + \frac{\partial (uCh)}{\partial x} + \frac{\partial (vCh)}{\partial y} = \frac{\partial (hD_{xx} \frac{\partial c}{\partial x} + hD_{xy} \frac{\partial c}{\partial y})}{\partial x} + \frac{\partial (hD_{yx} \frac{\partial c}{\partial x} + hD_{yy} \frac{\partial c}{\partial y})}{\partial y}
\]

In this equation, \(C(x, y, t)\) — material concentration; \(u(x, y, t)\) , \(v(x, y, t)\) — velocity of flow in the \(x\), \(y\) direction; \(h(x, y, t)\) — depth; \(D_{xx}(x, y, t)\), \(D_{xy}(x, y, t)\), \(D_{yx}(x, y, t)\), \(D_{yy}(x, y, t)\) — dispersion coefficient.

(2). Langevin Equation

In the random walk model, the location of each particle can be described by the nonlinear Langevin equation.

\[
\frac{dx}{dt} = A(x, t) + B(x, t) \cdot \xi(t)
\]

In this equation, \(A(x, t)\) — certainty function acting on \(x(t)\); \(B(x, t)\) — tensor the expression random function; \(\xi(t)\) — random vector.
(3). Current Velocity Simulation

① Planar Velocity Field Simulation

In this study, a depth-averaged planar two-dimensional hydrodynamic model is used for the simulation of velocity field, with the former equation.

② Supposition of Velocity Vertical Logarithmic Distribution

\[
V(z) = \frac{U_f}{\kappa} \left(\ln\left(\frac{h - z}{k_n/30}\right) + 8.6\kappa\right)
\]

In this equation, \( z \) —— the vertical coordinate from surface water downwards; \( V(z) \) —— velocity logarithmic distribution; \( \kappa \) —— Von Karman constant; \( h \) —— water depth; \( k_n \) —— Nikuradse; \( U_f \) —— friction velocity:

\[
U_f = \frac{V_{mean} \cdot \kappa}{8.6\kappa - 1 + \ln\left(\frac{h}{k_n/30}\right)}
\]

In the equation, \( V_{mean} = \sqrt{u^2 + u_b^2} \).

(4). Synthetic Function of Wind and Current

① Wind Drift Vector

In the flowing waters, the film will flow with the drift, and its drift speed and direction are generally consistent with the current; if there is wind at the surface, the actual film movement is the vector of wind drift and flow movement.

With different depths of water, wind effects film drift to different extents. According to the critical water depth of \( h_{sep} \), the waters id divided into near-shore and off-shore waters, in which different equations are adopted to calculate the wind drift vector.
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

Figure 22.3-1 Sketch Map of Waters Division Influenced by Wind

② Off-shore Formula

The formula of wind drift vector in off-shore waters is written as:

\[ C_w (z) = c_w^* \exp(-k_0 z) \quad 0 \leq z \leq h_w \]

In the formula, \( k_0 = \frac{3}{h_w} \), \( h_w \) —— water depth influenced by wind; \( z \) —— the vertical distance from surface water; \( c_w^* \) —— wind drift factor.

③ Near-shore Formula

The formula of vertical distribution of wind drift vector in the near-shore is written as:

\[ C_w (z) = c_w^* \left(1 - \frac{3z}{h} \right) \left(1 - \frac{z}{h} \right) \]

In the formula, \( h \) —— water depth; the others is as former ones.

④ Wind Deflection Angle

Due to the effect of Coriolis force, an angle exists between the wind drift vector and the wind direction, called wind deflection angle, right in the northern hemisphere, left in the Southern Hemisphere. Its formula is written as:
\[
\theta_w = \beta \exp \left( \frac{\alpha U_w}{g \gamma_w} \right)
\]

In the formula, \( \alpha = -0.3 \times 10^{-8} \); \( \beta = 28^38^1 \); \( \gamma_w \) —— dynamic viscosity of water.

With the synthetic function of wind and current, the total drift speed of film is written as:

\[
\vec{U}_{tot} = c_w(z)\vec{U}_w + c_a(z)\vec{U}_a
\]

In the formula, \( \vec{U}_w \) —— wind speed; \( \vec{U}_a \) —— current velocity; \( c_w \) —— wind drift factor; \( c_a \) —— current factor.

22.3.3.4 Predictive results:

According to the oil spill drift and diffusion after spilling accidents happened in the finished products pier that are predicted by the model and sources intensity mentioned above, see Figure 22.3-3 to Figure 22.3-7. According to the predictive results, the following conclusions can be drawn:

(1). The oily pollutants, after leaking into Yangtze River, along with the tide, flow to the upstream alongshore, which impact range will cover the intake of Chenhang Reservoir.

(2). The impact, due to spilling, on the water quality in the water area near the intake of Chenhang Reservoir, will basically vanish in 48 hours.
Figure 22.3-2 Film Pollution Zone Caused by Oil Spilling

Figure 22.3-3 Film Pollution Zone Caused after Oil Spilling Happened 9 Hours Later
Figure 22.3-4 Film Pollution Zone Caused after Oil Spilling Happened 24 Hours Later

Figure 22.3-5 Film Pollution Zone Caused after Oil Spilling Happened 31 Hours Later
Figure 22.3-6 Film Pollution Zone Caused after Oil Spilling Happened 48 Hours Later

Figure 22.3-7 Film Pollution Zone Caused after Oil Spilling Happened 72 Hours Later
22.4 Measures of Environmental Protection

22.4.1 Measures of Environmental Protection in the Construction Period

(1). Measures on the Prevention and Control of Water Pollution in the Construction Period

- All the refuses in the construction sites should be stored at the appointed place and be cleaned timely, and it is not allowed to dump randomly. The measures on the prevention of rain and leakage should be enhanced to reduce the loss caused by scouring. Also the measures prevent particulate matters and soluble hazardous substance flowing into receiving body of water along with the runoff of rain, which could finally pollute and silt the sewers in the city.

- The drainage destination shall be strictly regulated in the construction site, and drainage open channel and sedimentation tanks shall be designed before construction, to be used for muddy water generated from the site, wastewater produced by washing vehicles and drainage water, which sedimentary mud shall be transported out regularly and timely.

- The site sewage and toilet flushing wastewater shall be pre-treated by temporary septic tanks, and received and processed by the commissioned sanitation department.

- In the site, the principle of "let prevention dominate" shall be carried out, and the system of protection of the water environment shall be established and improved.

(2). Measures on the Protection of Atmosphere Environment in the Construction Period

- In the construction period, the measure of spraying water to suppress dust shall be adopted to the roads bearing the traffic of freight cars, which can effectively control the floating dust during the construction. If spray water 4 to 5 times per day, the floating dust can be reduced about 70%, and TSP pollution distance can be reduced into the range of 20 to 50m. Table 22.4-1 records the experiment results of spray water to suppress dust in the construction site.

<table>
<thead>
<tr>
<th>Distance (Meter)</th>
<th>5</th>
<th>20</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSP Hour Average Concentration (mg/m³)</td>
<td>Not spray water</td>
<td>10.14</td>
<td>2.89</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>Spray water</td>
<td>2.01</td>
<td>1.40</td>
<td>0.67</td>
</tr>
</tbody>
</table>
In order to reduce the home-made dust, it is suggested to use the commercial concrete and to send it directly to the construction site by the specified vehicles. A little scattered cement, when be unpacked and landed, shall be closed as a measure of protection.

Reinforce the repairing and maintenance of equipments and vehicles, and prohibit that the overload operation of construction equipments using diesel oil as its fuel that eliminate the pollutants emission.

The construction unit shall present the control and prevention plan for floating dust pollution to the regional construction administrative authority in the place of reported construction location for the record, within 3 business days before the day on which the project is to be started.

(3). Measures on the Protection of Sound Environment in the Construction Period

Strictly implement the relevant provisions in “Shanghai Environmental Protection Regulations,” that high noise mechanical operations as piling operations and Pneumatic Pick Housing are prohibited from 22:00 pm everyday to the next day 6:00 am; if the project operation is urgently needed at night, construction unit should apply to the local Environmental Protection Bureau, and then the operation at night, once being approved, shall be carried out in the specified dates.

Simple mobile noise barriers shall be installed and increased near high-noisy equipments, to reduce the impact of equipments and facilities’ noise on the environment. Strengthen the management of handling process that metal materials, when landing, are required to be lifted and laid lightly, to avoid the brutal operation resulting in artificial noise pollution.

The construction unit should strictly implement the regulations in “Noise Limits for Construction Site” (GB12523-90); see Table 22.4-2 for details.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Major Noise Sources</th>
<th>Noise Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Excavation</td>
<td>Bulldozer, grab, loader…</td>
<td>75</td>
</tr>
<tr>
<td>Piling</td>
<td>All kinds of pile drivers and others</td>
<td>85</td>
</tr>
<tr>
<td>Structure</td>
<td>Mixer, concrete vibrator, power saw…</td>
<td>70</td>
</tr>
<tr>
<td>Fitment</td>
<td>Crane, elevator…</td>
<td>65</td>
</tr>
</tbody>
</table>

(4). Measures of Biological Environmental Protection in the Construction Period
The pier construction period shall be, as far as possible, to avoid the breeding season of aquatic organisms in Yangtze estuary in order to reduce the loss of fisheries resources, which is the period of April to August. It is suggested to reduce the construction intensity of dredging and cleaning up, because this period is the season of the benthic organisms spawning and coilia spawning and nestng, and Collia ectenes upstream spawning, also is the downstream migration season of juvenile Chinese Sturgeon, especially that in the crab traced season the early and middle parts of June construction intensity should be controlled to reduce the loss of fisheries resources.

22.4.2 Measures of Environmental Protection in the Operation Period

(1). Measures of the Prevention and Control of Water Pollution

The oily sewage produced by the facilities for repairing equipments, is collected into production area in the plate, and then treated with the oily waste water together. The sewage from living is planned to be send to the Shidongkou Wastewater Treatment Plant through the sewers in the plant. A docking ship should be installed an oily water separator, and ensure its operation. The sewage from ships is collected and treated by the department of maritime affairs. It is not allowed to discharge such matters into Yangtze River, as oily waste water and sewage from ships, and oily waste water produce when repairing equipments, and sewage from buildings.

(2). Measures of the Protection of Atmosphere Environment

The finished products pier does not affect the local atmosphere environment seriously, because it is located at the shore of Yangtze River in the north of the plate, being close to the main channel of Yangtze River, and far away from shores.

Suggest to reinforce the repairing and maintenance of equipments and vehicles, and prohibit that the overload operation of construction equipments using diesel oil as its fuel that eliminate the pollutants emission.

(3). Measures of the Protection of Sound Environment in the Operation Period

Noise in the operation period are mainly the noise of equipments for cargo work and transportation vehicles in operation and ships, and the following measures is advised to reduce the noise impact:

- The specific noise control measures shall be adopted to high noise equipment, such as: acoustic enclosures of the cable car and other kinds of electrical power equipment; operators shall ensure personal protection measure
I Strengthen the maintenance of machinery, vehicles and equipments, and maintain normal operations, and reduce noise

I Considering the traffic noise, vehicles is suggested to slowdown to reduce honing before entering into the pier.

I Layout shall be distributed rationally and green isolation belt shall be built to reduce the noise impact on the surrounding acoustic environment quality in the handling operation.

(4). Measures on the Prevention and Control of Solid Waste

During the period of operation, solid wastes on the pier are mainly production refuses and garbage, and the rubbish from ships, and the following corresponding measure is to be applied:

I The respective dustbins are set to collect production refuses and garbage collection on the pier, such as three bins set for respectively collecting general industrial waste, hazardous wastes (such as old batteries, waste lamp bulbs, electronic devices, etc.), and garbage. Refuse is unifiedly arranged to collect by relevant departments in the company, and delivered to collection station in the Pusteel Company, and then processed together by the outsourcing of Pusteel Company.

I Ship companies should carry out the daily garbage collection, sorting and storage, and regularly commission to receive and process the garbage. Garbage from ships contains dangerous materials or other poisonous substances, so ship companies should provide material name, nature, number, and other information to the pollutants receiving and processing unit, and this garbage is collected together to be send to the dump.

(5). Protection Measures to the Ecological Environment

I Building green shelterbelt should select appropriate plant species. General principles and requirements are that firstly, the selected plant shall be anti-pollution, absorb toxic gas, clean the air and insulate noise, and offer shading, and it is considered to be with certain ornamental value, but it should also be considered that the requirements of this plant on the local climate, the adaptability to soil conditions and sanitary condition.

I The tree, adapting its growth to Shanghai, with the function of strong pollution-resistance shall be selected. In the port, the following tree species can be planted: privet, phoenix tree, pittosporum, oleander, elm, Ailanthus, acacia, dragon juniper, chinar, corals, magnolia grandiflora and others. If plant tall evergreen trees with broad leaves, cinnamomum camphora and magnolia grandiflora are recommended; if plant evergreen broad-leaved shrubs, oleander,
pittosporum, and distylium are recommended.

Shelterbelt structure can use the combination of trees, shrubs and grass which form one continuous and close shelterbelt with a best porosity of less than 0.1 degree.

22.4.3 Measures to Control and Prevent the Risk of the Oil Pilling

(1). Oil Pollution Contingency Plans and Emergency Response Procedures

The oil contingency plan shall be made in the port, and its content shall include that:

- the report procedure;
- necessary contingency measures;
- the description of contingency measures;
- person of responsibility and extent of responsibility.

The oil pollution contingency response procedure is shown in the Table 22.4-1.
Table 22.4-1 Contingency Response Procedures

(2) Reinforce the Management of Preventing Pollution

According to the relevant regulations of Ministry of Communications, freight terminals are not insisted to install oil spill contingency equipments. However this pier, being near to Chenhang Reservoir, should be set oil column, oil skimmer, degreasing agents and other facilities. Once oil spills accident happened on the pier, reporting to the Shanghai Maritime Bureau supervision stations in a timely manner, with the emergency rescue services offered by Shanghai Harbor Engineering Corporation or Dongan on-Sea Oil Spill Accident Emergency Center arranged by Shanghai Maritime Bureau, the self-rescue shall also be carried out.

According to the statistics of oil pollution occurrence, oil pollution accidents, caused by the failure of pre-inspection implemented by personals of ship and pier, are accounted for a large proportion, therefore they must be in accordance with the specifications, implement the pre-inspection, seriously execute the inspection system of operation safety, which check and implement one by one, not allowing to go through the motions.

Strengthen on-duty management, and in the event of oil spills, staffs on duty shall take immediate and effective oil non-proliferation measures in the first time.
23  Conclusions and Suggestions

23.1  General Conclusions

23.1.1  Pusteel relocation project is the basis for successfully holding the Shanghai World Expo on December 3rd, 2002, with the official announcement from Monte Carlo, Monaco, Shanghai. Finally was elected as the host of World EXPO in 2010, which is the glory of China, also the glory of Shanghai. People in Shanghai, supported by government, will hold it as a most successful, most wonderful, and most unforgettable international fair in history. The site of World Expo 2010 will be located in the waterfront between Lupu Bridge and Nanpu Bridge with the area of 5.28 km², which main body will be finished before the end of 2007. Pusteel, occupied the area of 2.18 km² accounting for 40 percentage of land for World Expo, is required to be entirely moved out in 2006. Pusteel's relocation on schedule is the basis for successfully holding the Shanghai World Expo. For supporting and assisting the construction and holding of Shanghai World Expo, Pusteel, considering the general situation, will start the removal and move to the Luojing Area of Baoshan on schedule.

23.1.2  This project is in accordance with the state industrial policy.

According to the spirit of "document [2002] No. 444 of State Economy Trade Tech" (Notice on printing and distributing "State Industrial Technology Policies"), "the Interim Provisions for Promoting Industrial Structure from State Development and Reform Commission", and "on Transmitting and Issuing Several Opinions of the National Development and Reform Commission and Other Departments on Curbing Irrational Investment in Steel, Electrolytic Aluminum and Cement Industries" (Decree No.103 [2003]) issued the State Council of the People's Republic of China. In December, 2003, the technologies adopted in this project, in accordance to state industrial policy, are all the advanced manufacturing technologies encouraged to develop by the "Catalogue of Products and Technology Currently Particularly Encouraged by the State for the Development" (edited in 2000) and the "Catalogue of Readjustment of Industrial Structure" (draft).

23.1.3  In this project, the construction is consistent with the planning.

According to "General Plan of Shanghai", steel, petrochemical, automobile and other industries are to be mainly developed out of the outer ring. Baoshan district is the only area for developing the steel industry as a pillar industry in Shanghai. Therefore, it is in accordance with the requirements of the General Plan and
industrial distribution of Shanghai to move Pusteel to Luojing Area of Baoshan.

23.1.4 This project is in accordance with the requirements of clean production.

COREX technology is an advanced melting reduction process using non-coking coal as the reducer, which, compared with the traditional steel-making technology with blast furnace, could save coke over 400 thousand ton, coking coal over 500 thousand ton; and in which, by adopting the pure-oxygen to support the combustion, the heat value, to be utilized further and more effective, of coke gas produced could be much higher than of blast furnace gas; and which bring out the great decrease in the amount of \( \text{SO}_2 \) discharge (produced by burning COREX gas as the fuel).

The incoming materials in the raw material yard are all accepted raw and supporting materials. Without the processing facilities for crushing, screening in the raw material yard, the transferring of raw and supporting materials and the loading in the production workshop are both adopted the measures of closure and bag filter that effectively control the industrial fugitive dust produced in the production process.

Coke gas in the steel-making process is used as a fuel in the heating furnace of steel rolling system, which its complete and comprehensive utilization could be conducted in the ordinary production process; no fuel melting boiler is installed in the plate, and the steam used in production and living is all produced and offered by the remaining hot boiler.

The discharged wastewater of clean circulating water system in every plate is used as the makeup water in the turbid circulating system; the discharged wastewater in the turbid circulating system is discharged into the central wastewater treatment plate, and 2/3 of it, being further comprehensive treated, is reused to the production process; that the repeated utilization of water in the entire construction project is 98%.

According to the “Standards for Clean Production in the Iron and Steel Industries” (draft), the designing indicator could reach to the Class one of clean production level, that is, the international advanced level of clean production.
23.1.5 Pollutants Emission Control

(1) Pollutants Control Measures
Table 23-1 Pollutants Control Measures in this Project

<table>
<thead>
<tr>
<th>Pollution Sources</th>
<th>Major Pollutants</th>
<th>Initial Plan for Pollution Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage and transporting of mine materials</td>
<td>Dust</td>
<td>Spraying liquid to suppress dust, and bag dust filter</td>
</tr>
<tr>
<td>Corex Furnace, MIDREX Furnace, Pretreatment of Molten Steel, Converter of 150 t, Electric Furnace of 100 t, Refining System, Continuous Casting System, Heavy Plate Rolling Mill, Steckel Mill, Lime Kiln</td>
<td>Dust</td>
<td>Bag dust filter</td>
</tr>
<tr>
<td>Heavy plate mill furnace, CCPP</td>
<td>NO&lt;sub&gt;x&lt;/sub&gt; and SO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Adopting low NO&lt;sub&gt;x&lt;/sub&gt; combustion technology</td>
</tr>
<tr>
<td>Rushing slag system</td>
<td>SS etc.</td>
<td>Sedimentating and recycling</td>
</tr>
<tr>
<td>Gas scrubbing wastewater</td>
<td>SS</td>
<td>Sedimentating and cooling and then recycling</td>
</tr>
<tr>
<td>Indirect cooling water</td>
<td>Temperature raises</td>
<td>Cooling and then recycling</td>
</tr>
<tr>
<td>Turbid wastewater</td>
<td>SS and petroleum oil</td>
<td>Sedimentating, deoiling, cooling and then recycling</td>
</tr>
<tr>
<td>Mixed acid wastewater</td>
<td>Cr&lt;sup&gt;6+&lt;/sup&gt;, Ni&lt;sup&gt;2+&lt;/sup&gt;, Fluoride</td>
<td>Neutralize the sedimentation after reduction, and then carry out Gore-filter</td>
</tr>
<tr>
<td>Wastewater drained by production system of the whole plant</td>
<td></td>
<td>Treated by central wastewater treatment station and then 2/3 is reused, the 1/3 is drained</td>
</tr>
<tr>
<td>Sewage from the whole plant</td>
<td>SS, COD, BOD, NH&lt;sub&gt;3&lt;/sub&gt;N, animal and vegetable oils</td>
<td>Bring under municipality wastewater pipe, send to Shidongkou Wastewater Treatment Plant to treat and drain after meets standards</td>
</tr>
<tr>
<td>Corex furnace slag</td>
<td></td>
<td>Utilized as building raw materials</td>
</tr>
<tr>
<td>Steel slag</td>
<td></td>
<td>Utilized as building raw materials after recovery</td>
</tr>
<tr>
<td>Hot metal desulphurizing slag</td>
<td></td>
<td>Utilized as building raw materials</td>
</tr>
<tr>
<td>Iron oxide scale</td>
<td></td>
<td>Utilized as raw materials of steelmaking</td>
</tr>
<tr>
<td>Dust &amp; mud containing iron</td>
<td></td>
<td>Utilized as raw materials of pellet</td>
</tr>
</tbody>
</table>
(2). The discharging amount of pollutants in this project

Table 23-2 discharging amount of pollutants in this project

<table>
<thead>
<tr>
<th>Pollutants Index</th>
<th>First Step</th>
<th>Second Step</th>
<th>Solid Waste Index</th>
<th>First Step</th>
<th>Second Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Amount of Exhaust air</td>
<td>4701400</td>
<td>8466500</td>
<td>Corex Furnace Slag</td>
<td>49.4</td>
<td>98.8</td>
</tr>
<tr>
<td>Dust</td>
<td>841.7</td>
<td>1509.3</td>
<td>Iron Slag</td>
<td>21.0</td>
<td>34.5</td>
</tr>
<tr>
<td>NO\textsubscript{x}</td>
<td>1618.5</td>
<td>2838.3</td>
<td>Hot Metal Desulphurization Slag</td>
<td>0.75</td>
<td>1.5</td>
</tr>
<tr>
<td>SO\textsubscript{2}</td>
<td>692.1</td>
<td>1332.9</td>
<td>Iron Scale</td>
<td>2.2</td>
<td>4.33</td>
</tr>
<tr>
<td>Fluoride (count in F)</td>
<td>3.56</td>
<td>5.17</td>
<td>Iron-containing Slime and Reclaimed Dust</td>
<td>9.5</td>
<td>15.3</td>
</tr>
<tr>
<td>Total Amount of Wastewater</td>
<td>193.92</td>
<td>200.39</td>
<td>Waste Oil</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>SS</td>
<td>135.75</td>
<td>140.27</td>
<td>Waste Fire-resistant Material</td>
<td>1.9</td>
<td>3.1</td>
</tr>
<tr>
<td>COD</td>
<td>135.75</td>
<td>140.27</td>
<td>Wastewater Treatment Sludge (Dry)</td>
<td>0.78</td>
<td>0.96</td>
</tr>
<tr>
<td>Petroleum Oil</td>
<td>9.70</td>
<td>10.02</td>
<td>Chromium-bearing Sludge</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Fluoride (F)</td>
<td>2.00</td>
<td>1.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cr\textsuperscript{6}</td>
<td>0.050</td>
<td>0.037</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-Ni</td>
<td>0.100</td>
<td>0.075</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-Cr</td>
<td>0.150</td>
<td>0.112</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(3). Pollutants Emission Control

Analyzing the pollution control effect of metallurgical industry at present in China, bag filter system used in smoke and dust pollution sources of the relocation project, by adopting the membrane filter media, could completely meet the requirement that control the concentration of discharged dust fewer than 35 mg/Nm\textsuperscript{3}; the fuel used in the rolling heating furnace and others, containing H\textsubscript{2}S 70~100 ppm, and the SO\textsubscript{2} concentration of its flue gas could be ensured fewer
than 100 mg/Nm$^3$ (the standard is 550 mg/Nm$^3$); In the combustion system using industrial gas as the fuel, ordinarily, the NO$\textsubscript{x}$ concentration of its fume could be ensured fewer than 240 mg/Nm$^3$, which will be much fewer by adopting the low NO$\textsubscript{x}$ burner in the rolling heating furnace.

Analyzing the discharged water quality, and the control measures and effect of water pollution in the metallurgical industry at present in China, the production wastewater produced in every production system of the relocation project, adopting the advanced treatment technology that the wastewater is used circulatively after being purified by the self water processing facilities, and that the discharged wastewater in the turbid circulating system is sent into the central wastewater treatment plate to be re-purified (detail view in the construction analysis), could completely meet the standards for water pollutants discharge, executed in the relocation project.

23.1.6 After relocation, the total amount of discharged pollutants decreases appreciably and is balanced basically.

The major pollutants in this project, under control, are SO$\textsubscript{2}$, industrial dust and industrial solid wastes. According to the “Shanghai Corporation and Institution Pollution Discharge Licenses” (License No.:115000119), the approved discharging amounts of SO$\textsubscript{2}$ and industrial dust are respectively 1355.1 t/a and 2129.34 t/a in the Pusteel. After the production conduct of the first-step construction in this relocation project, the discharging amounts of SO$\textsubscript{2}$ and industrial dust are respectively 691.2 t/a and 841.7 t/a, far less than the approved discharging amount in existence. After the production conduct of the second-step construction, the discharging amounts of SO$\textsubscript{2}$ and industrial dust are respectively 1332.9 t/a and 1509.3 t/a, also far less than the approved discharging amount in existence. The industrial solid wastes are all treated by means of resource recovery, minimization and harmlessness.

23.1.7 Area environmental quality meets the requirement of functional domain basically.

(1). Environmental air quality exceed standard.

The monitoring records in fall indicates that the hourly concentration and daily average concentration of SO$\textsubscript{2}$, NO$\textsubscript{2}$, PM$\textsubscript{10}$, TSP and fluoride in every monitoring point were all below the State Standards Class two, required in the “Ambient Air Quality Standard” (GB3095-1996). The monitoring records in winter, on January, 2005, indicates that the hourly concentration and daily average concentration of SO$\textsubscript{2}$, NO$\textsubscript{2}$, PM$\textsubscript{10}$, TSP and fluoride in every monitoring point were all below the State Standards Class two, required in the “Ambient Air Quality Standard”
Environmental Impact Report on Pusteel Relocation Engineering of Baosteel

(GB3095-1996); however, PM$_{10}$, TSP exceeded the standards to various extents, in which the maximum daily average concentration of TSP exceeded the standards 1.27 times, definitely due to integrated factors as dry weather condition, land surface exposure, floating dust caused by the dry wind, influence by the removal and demolition, the imperfection of traffic facilities and other factors. According to the environmental quality report in 2003 of Baoshan district, the annual average concentration of SO$_2$, NO$_2$ in the air of the whole Baoshan district reached the standards of functional domain, and TSP concentration exceeded the annual average standards of functional domain(0.2 mg/m$^3$).

(2). Surface water quality meets the requirement of functional domain basically.

I Surface Water of Inland Rivers

The area for this project is on the upstream of the place for diverting water to flush out pollutants in Baoshan district. During the period of monitoring, Surface Water of Inland Rivers basically met the requirement of water quality type IV.

<table>
<thead>
<tr>
<th>Concentration Range</th>
<th>pH</th>
<th>BOD$_5$</th>
<th>COD$_{Cr}$</th>
<th>CN$^{-}$</th>
<th>Petroleum Oil</th>
<th>NH$_3$-N</th>
<th>Cr$^{6+}$</th>
<th>Volatile Phenol</th>
<th>Fluoride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>8.10</td>
<td>6.2</td>
<td>32.0</td>
<td>&lt;0.004</td>
<td>0.17</td>
<td>3.66</td>
<td>&lt;0.004</td>
<td>0.005</td>
<td>0.78</td>
</tr>
<tr>
<td>Minimum</td>
<td>6.87</td>
<td>3.3</td>
<td>18.2</td>
<td>&lt;0.004</td>
<td>0.04</td>
<td>0.38</td>
<td>&lt;0.004</td>
<td>&lt;0.002</td>
<td>0.24</td>
</tr>
<tr>
<td>Standard Type IV</td>
<td>6-9</td>
<td>6</td>
<td>30</td>
<td>0.2</td>
<td>0.5</td>
<td>1.5</td>
<td>0.05</td>
<td>0.01</td>
<td>1.5</td>
</tr>
</tbody>
</table>

I Water Quality of Local Yangtze River

According to the “Report on the Environmental Quality in Shanghai” (2001~2003) compiled by Shanghai Environment Monitoring Center, pH, DO, COD$_{Cr}$, BOD$_5$, volatile phenol, fluoride, hexavalent chromium (Cr$^{6+}$) in the sections of Liuhekou, Chenhang Reservoir and Wusong met the requirements of type II functional domain and NH$_3$-N, petroleum oil and total phosphor exceeded the standards, regarded as type IV water.

Shanghai branch of Water Environment Monitoring Center of Changjiang Watershed, consigned by Shanghai Environmental Science Institute, set up 3 sections and 3 perpendiculars at the upstream where is 2 km from Shitongkou Wastewater Plant, at the Plant and at the downstream where is 4 km from the Plant, to monitor the dry season of Yangtze River, which results indicate: pH, DO,
COD_{Cr}, BOD_5, volatile phenol, fluoride, hexavalent chromium (Cr^{6+}) and petroleum oil in these three sections met the requirements of functional domain, however, NH_3-N in several perpendicular, and COD_{Cr} in all the sections and perpendiculars, and total phosphor generally in two sections didn’t meet the requirements. The result of monitoring on COD_{Cr} in the section of down stream, at the lowest ebb is lower that it at the highest flood.

(3). Noise discharged at the boundary of the plant all reaches the standards.

Noise discharged at the boundary of the plant, at the base of this project, is less than 65.9 dB(A) in daytime and less than 54.8 dB(A) in nighttime, of which one monitoring point beside the road shall execute the standard IV; except the data of this monitoring point, other monitoring points are all in accordance to “Standard of noise at boundary of industrial enterprises” Type III that the standards in daytime and nighttime are respectively 65 dB(A) and 55 dB(A).

(4). The quality of ground water is basically fine.

In the project area, of all monitoring factors in the ground water, fluoride, permanganate index, pH and hexavalent chromium meet the requirements of water quality Type I, and total hydrogen cyanide and nickel meet Type II, and volatile phenol and NH_4 meet Type III—IV, which indicates the quality of ground water in the project area is basically fine. The ground water in the project area, except used for agriculture and part of industry, also could be used as drinking water after appropriate treatment.

(5). The quality of soil environment is basically fine.

The site selected for the project have always been used as farmland for many years, basically not influenced by heavy metal pollution, which present condition of soil environment quality basically reaches at Standards Level 1.

23.1.8 The construction of project impacts the environmental air quality indistinctively.

(1). After the completion and commissioning of construction, it is calculated that, by superposing the background values and predictive values in fall, the maximum of typical daily average concentration of SO_2, NO_2, PM_{10} and F are respectively 0.019 mg/m^3, 0.052 mg/m^3, 0.080 mg/m^3 and 3.1 μg/m^3. And, by superposing the background values and predictive values in winter, the maximum of average concentration of SO_2, NO_2, PM_{10} and F in the typical days are respectively 0.055 mg/m^3, 0.075 mg/m^3, 0.195 mg/m^3 and 3.1 μg/m^3. Therefore, SO_2, NO_2 and F in the typical days of fall and winter all meet the requirement of standard Class two.
of environmental air quality; And the winter superposed concentration index of PM$_{10}$ in Shangqiao will exceed the standard, because the monitoring result of PM$_{10}$ in winter in Shangqiao did exceed, however the predictive concentration of typical days in Shangqiao, in this project, is only 6.7% of standard Class two of environmental air quality.

(2). On condition of shoreline fumigation, the maximum ground concentrations of SO$_2$ and NO$_2$, respectively 0.09 mg/m$^3$ and 0.15 mg/m$^3$, both reach to the limitation index in standard Class two of environmental air quality; and the maximum ground concentrations of PM$_{10}$ will reach 0.60 mg/m$^3$, most of which fall in the inner of plant that impact every sensitive point not much.

23.1.9 Then impact extent of wastewater discharge on the Yangtze River is small.

(1). Recommend plan for discharging wastewater into Yangtze River estuary

On the hydrological condition during the dry season, the tail water from Pusteel discharged into Yangsheng River will severely affect the water quality of Yangsheng River, West Suitang River and small channels nearby. If the water diversion plan is not executed, the discharged pollutants of the project will markedly affect the water quality of Yangsheng River, West Suitang River and reaches nearby; it is approximately 1 km that is the lengths of reaches, in which the increments of COD$_{Cr}$ concentration exceeding 30 mg/L and exceeding 20 mg/L, and of BOD$_5$ concentration exceeding 6.0 mg/L and 4.0 mg/L, are respectively 1 km, 1.8 km, 1.0 km and 1.7 km. Therefore, even if without the consideration of background concentration, COD$_{Cr}$ and BOD$_5$ concentration in the nearly 1 km reach of Yangsheng River both have exceeded the standards of type IV of water quality due to the discharged pollutants of the project.

Compared with the inexecution of this water diversion plan, the water diversion plan for dry season could reduce the increment of pollutants concentration caused by discharging pollutants into Yangsheng River and channels nearby; this plan, after execution, will improve the water quality of river network near sewage outlet with indistinct effect, but the discharged pollutants of the project will still have the distinct and negative impact on the water quality of Yangsheng River and channels nearby.

Although the water diversion plan could improve the water environmental capacity of Yangsheng River to a certain extent, the discharging amounts of COD and petroleum oil in the project are still more than the water environmental capacities of reaches planned for discharging.(the reach from West Suitang River to Yangsheng River in Gujing)
(1) On the negative hydrological conditions of dry season and neap, discharging tail water into Yangtze River estuary will not form a distinct pollution zone in the waters near the sewage outlet, and affect little on the water quality of sensitive waters as Chenhang Water Source Reserve, being neglected comparing with the Background water quality concentration in this waters, far from enough to change the water quality type in this waters.

(2). The water quality of Yangtze River is little affected by warm discharging water.

According to the result of far-zone numerical simulation of CCPP warm discharging water, the influence of the side warm discharge is more serious than the alongshore and the off-shore discharge, and the temperature rise in winter is a little bit higher than it in summer. However, whether in the plan of side discharge, alongshore discharge or off-shore discharge, the waters with the average temperature rise of \( \geq 1.0^\circ C \) are all smaller than 1600 m\(^2\).

The result of near-zone numerical simulation of warm discharging water indicates that the pinnate warm water zone in the near zone, formed after the warm water discharging, continually rises by mixing with and diluted by surrounding water until reaching to the surface, with the drastic drop of the water temperature. At the ebb, the temperature rise and area of warm water zone formed by off-shore discharge is about 1\(^\circ C\) and 600~700 m\(^2\) when it rises and arrives at the surface of water; the temperature rise and area of warm water zone formed by alongshore discharge is about 1.7\(^\circ C\) and 320 m\(^2\) when on the same condition.

(3). During the construction of dock, dredging and desilting mainly are SS influences

During the period of construction of dock, Cutter-suction dredges of 1500 m\(^3\) are planned to be used for dredging and desilting in the port area, and dredging will mainly cause the suspended particulate pollution in the water. Through analyzing, the average concentration of vertical distribution of suspended sediment is about 700~1000 mg/l in the central area of operation by cutter-suction dredges; Out of the central area, maximum increment of partial water body in Yangtze River is about 300~500 mg/l, and the maximum impact extent from 5 km upstream to 8 km downstream; the maximum contribution of concentration to Chenhang Reservoir intake could reach to 100 mg/l, and in-taking water in Chenhang Reservoir stay in the it for 7~10 days long enough for the sedimentation of suspended matters, so water quality in the reservoir is little affects by the increasing of suspended matter concentration at the intake. Along with the completion of construction, the water quality could resume the present background level.
23.1.10 Noise in nighttime has an impact on the area of the boundary of factory.

After the commissioning of this project, the sound level of every plant boundary is not affected much in daytime that by superposing with the background value, the sound level of the plant boundaries in northeast, northwest and southeast basically could still be maintained as required in the class III standard, and that the plant one in southwest, bordering on Beiyunchuan Road, could also meet the requirement of the class IV standard.

In nighttime, the sound level of every plant boundary is affected to various extents that by superposing with the background value, the sound level of every plant boundaries exceeds the standards to various extents, which the sound levels of the plant boundaries in northeast, northwest, southeast and southwest exceed the standard 4.3 dB(A), 1.3 dB(A), 5.3 dB(A) and 8.6 dB(A) respectively. After analyzing reasons, exceeding the standard at the plant boundaries in northeast, are mainly caused by the oxygen station and the Midrex workshop, in northwest by the hot rolling steckel workshop, in southeast by limekiln and CCPP generating units, and in southwest by CCPP generating and the steelmaking and continuous casting workshop.

23.1.11 The aquatic organism is not affected by warm discharging water.

The area for discharging warm water in the project is located on the continental branch of the entrance area of the Yangtze River in Baoshan, with a long history of development and utilization, in which the beach wetland is affected comparatively great by the activities of human beings. This area is neither the breed field nor the habitat of rare animal, in which there is no special ecological sensitive object needed key protection, and the sensitiveness of aquatic eco-systems is not intense. The discharging amount of warm discharged water from Pusteel is one million m$^3$/d, and the difference in temperature between it and environmental water is 7 °C. However, due to the great discharge at the entrance area of the Yangtze River and the environmental features of the special macro-tidal estuary area, warm water diffuses rapidly, by which the temperature rising effect caused in nearby waters is not distinct, as average rising of temperature is less than 0.1 °C in the area of 1 km$^2$, so the temperature rising phenomena of water body will not occur that will not bring the negative effect on the aquatic eco-environment and the change of water quality.

23.1.12 The major Influence of gas cabinet leak is conducted in the plant.

(1). Based on the investigation, gas cabinet explosion accidents have never been happened until now in Shanghai, so haven’t the ones causing dead and hurt.
There are nearly ten fatal gas accidents happened annually in Shanghai, of which ones mainly resulted from pipeline gas leakage in the house.

(2). Pusteel is a large-scale iron and steel incorporated enterprise, and its 3 gas cabinets (total capacity: 330 thousand m$^3$) are identified as major risk sources in the stocking area in this project. It is forecasted that the diameter of the split is 0.1 m, when one of the three gas cabinets leaks. The leakage mainly impact on the inner area of plant, and on the workers in the plant, and rather severely on the staff near to the gas cabinets, but nearly no impact on the densely populated area as Chenhang Town and Shengqiao Town, which are 2 km away from the plant.

23.1.13 Any great spilling accident, if happened in the finished products dock, affects the Chenhang Reservoir.

The risk of the finished products dock is the spilling accident resulted from the ship collision. This project adopts the depth-averaged and two-dimensional quality transfer mode to predict the risk of spilling accident in the finished products dock that the actual spilling amount is 10 ton, and the wind-direction is southeast, and the wind speed is 3.4 m/s. The predictive results:

- The oily pollutants, after leaking into Yangtze River, along with the tide, will flow to the upstream alongshore, which impact range will cover the intake of Chenhang Reservoir.

- The impact, due to spilling, on the water quality in the waters near the intake of Chenhang Reservoir, will basically vanish in 48 hours.

23.1.14 Set the sanitary protective distance of 25 m to 340 m.

There are 4 non-organized discharging sources in the Pusteel relocation project, e.g. the stock yard, the steel-making system, the iron-making system and the slag depot. Being calculated, sanitary protective distances are set as following (factory boundary as a starting point): the sanitary protective distance, needed to be controlled, from the northeast and southeast sides of the stock yard, out of the plant boundary is 340 m; from the southwest side of iron-making system, is 195 m; from the southwest side of steel-making system, is 25 m. In this area, the outside of the plant boundaries in southeast and northeast is the constructed industrial land; the outside of the plant boundaries in southwest is Baoshan Industrial Zone, in which all the residents are to be moved out that charged by Baoshan Industrial Zone.
23.1.15 The majority of public are for the project.

- In this public survey, adopting the means of distributing the “Public Survey Questionnaire” on the website of Shanghai Environment Hotline and holding public consultation meetings at the surrounding area of construction site, totally interviewed 159 people, including all walks of life in the society expressing their opinions on the internet, civil servants in the town government, employees and workers from the corporate surrounding project construction site, and local residents.

  In the online survey, the interviewees with college education or higher made up 60%; in the spot survey, the ones made up 30%, and more than half of the interviewees were local workers and peasants.

- Most of the interviewees expressed that they had know and heard about the construction of this project in various ways, but there is still 12% of the public didn’t know it; 74% of the public are for Pusteel relocation project, and 16% against it.

- The opposed opinions were mainly focused on the pollution control effect of Pusteel after the construction of the project. The public expressed that it is untrustworthy that “the amount of wastewater, COD$_{Cr}$, petroleum oil, SO$_2$ and smoke and dust will be respectively reduced more than 90%, more than 90%, more than 95%, 65% and 60% after the implementation of the project”; they hoped Pusteel carry out the full demonstration and implementation on the pollution control and treatment. Otherwise, the interviewees, living at the area of this project, concerned that the living environment quality would be affected by the dust pollution after the implementation of the project, because the residential place is at the downwind of Pusteel; and express their dissatisfaction on the present site selection plan of Pusteel, and held the view that the sites for Pusteel's construction should be selected with alternative plans.

- All the interviewees being revisited, who not supported the project, expressed their trust in the predictive results of environmental impact from environmental impact assessment after they heard the major conclusions of environmental impact assessment report; according to the conclusion of that “the surrounding sensitive objects are not affected much by the project construction after the implementation of measures” drawn in the environmental impact assessment report, they supported the construction of this project. The public applauds the measures of changing the former technology and adopting clean production technology without sintering and coking, promised by Pusteel.
Regarding the implementation of measures on controlling the pollution in the project, the public expressed that on the basis of improvement of Pusteel self-conception, management department in the government shall enhance the supervision measure to ensure the emission control. As to the residents living in the protection distance area, construction units shall work with the relevant government departments to step up the implementation of the relocation.

23.1.16 Execute the environmental management and environmental monitoring after completion

(1). After the completion of this project, Pusteel shall, in accordant to the environmental laws, regulations and standards made by state and Shanghai Municipality, improve its environmental management system that establish the ISO14001 Environmental Management System as soon as possible, and well complete the management of the “three simultaneous” checking and accepting.

(2). Monitoring on the production wastewater: According to the actual situation of wastewater production in every workshop, it is suggested that water exiting in every set of sewage treatment plant is to be monitored, especially the water entering and exiting in the central treatment station; that the on-line monitoring equipment is to be installed to monitor the displacement and the general factor as \( \text{COD}_{\text{Cr}} \) at real time. The specific monitoring factors and monitoring frequency are expressed in Table 17-2.

(3). Monitoring on exhausted gas and ambient air: According to the actual situation of exhausted gas production in every production workshop, it is suggested to monitor the outlet of every exhausted gas treatment device. The specific monitoring factors and monitoring frequency to exhausted gas are expressed in Table 17-2.

In order to improve the level of pollution control further, Pusteel shall set the ambient air monitoring station around and in the center of the factory. The specific monitoring factors and monitoring frequency are expressed in Table 17-2.

(4). Monitoring on noise: It is required that construction unit should monitor the noise at the boundary of factory and of major equipments, and then find problems and adopt the measure of prevention and control. The specific monitoring factors and monitoring frequency are expressed in Table 17-2.

(5). Monitoring on water consumption: Pusteel shall install a water meter in every workshop and every part of production process that make sure the water balance of the entire factory, which offer a fundamental data for further saving water and
reducing the wastewater discharge.

(6). Monitoring on accidents: In case of the potential contamination accident as the malfunction of equipments, power cut, raw and supplementary material leakage when loaded and unloaded on the dock, fire and explosion, company should make administrative system and contingency measures, and prepare contingency facilities to monitor the pollution level caused by accidents, and to eliminate pollutants in time, which make the environmental loss lowest.

(7). Statistics and Analysis on the Monitoring Data: Adopting the monitoring plan above, the construction unit should input the monitoring and analysis results in to the computer and pigeonhole them. Then by comparing the results with standards, the construction unit should analyze the reason of being beyond the standards and put forward the plan for prevention and control.

(8). It is required that according to the specification, set up the sampling hole and the sampling platform in exhaust mast and sewage outlet during the period of construction.

23.2 Suggestions

(1). For the steel industry, the stock yard is one of the major pollution sources. In China, the watering or spraying liquid containing covering agent is the typical ways to suppress the dust, which is not up to much. It is reported that there is a kind of newly developed covering agent used at home in recent years with better effect achieved in the steel industry. To this end, it is recommended that the builder conduct some investigations at home and abroad on the steel industries with good experiences of dust control and draw lessons from them, so that the feasible measures could be taken to control the environmental pollution by the dust of the stock yard.

(2). VPSA tail gas contains comparatively high-concentration CO\textsubscript{2} and H\textsubscript{2}S, and coal gas from shaft furnace roof is sound medium caloric value coal gas with low-concentration CO\textsubscript{2} and H\textsubscript{2}S that if mix the two kinds of gas , the caloric value and the quality of the mixed coal gas would be lower to a certain extent. It is reported that “research on synthesis of biodegradable plastics by efficient catalyzing carbon dioxide in the nano-technology” in China has been successful, which products degradable plastics made by CO\textsubscript{2} emissions; according to another report, The world's largest production line with an annual output of carbon dioxide polymer of 3,000 tons has been built and put into production in China; furthermore, CO\textsubscript{2} in the air emissions can be also used to produce the gas fertilizer, edible dry ice and others. It is suggested that construction units shall
carry out the inspection on the utilization of carbon dioxide gas in domestic and abroad, and drawing on the advanced experience of VPSA to utilize the tail gas; therefore, construction units not only improve mixed gas product quality, but also further reduce the total emissions of SO$_2$, which both conduct the fine economic benefits.

(3). Mixed waste acid is treated by the neutralization method in the design; thus, not only the treatment load of acidic wastewater treatment plant, and the production of chromium-contaminated sludge are increased, but also the cost of production. At present, there are many comparatively mature methods used for the reproduction of waste acid produced by the stainless steel pickling, including sulfuric acid replacement vacuum distillation, free acid recovery, the whole acid recovery (baking); According to the project's specific conditions, the sulfuric acid replacement vacuum distillation method and the free acid recovery method are more suitable, which is suggested to positively adopted due to that Pusteel has the experience of mixed waste acid regeneration. Thus, not only the treatment load of acidic wastewater treatment plant, and the production of chromium-contaminated sludge are reduced, but also the cost of production is reduced by using regenerated waste acid.

When adopting the acid waste regeneration technology, it is a need to carry out specialized technical training to operation workers; meanwhile, a combination of mixed waste acid should be designed as large as possible, to avoid the impact on the acidic wastewater treatment system when mixed waste acid discharged into it during the equipment maintenance. As the waste acid containing highly corrosive hydrofluoric acid, anticorrosion measures shall be well implemented in equipment, pipeline, In particular pipe joints and other vital parts.

(4). In recent years, regenerative combustion technology or high temperature air combustion technology (HTAC), developed successfully and being comparatively mature in technology, has been vigorously promoting at present. The technique has many advantages, as high thermal efficiency of fuel, low steel burning, low emissions of NO$_x$ and CO$_2$, and good economic and environmental benefits, so being suggested to positively adopt.

(5). According to the "Management Approach on the Real-time Automatic Monitoring Systems for Major Pollutants from Pollution Sources in Shanghai", the wastewater and exhaust air, discharged from the production process in this project, should be installed the automatic monitoring system in match , which is suggested to implement in the next designing.

(6). The scruff and steel slag produced in the process of the production are general
industrial solid wastes, and the storage, disposal sites and management of which should be designed strictly in accordance with the Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2001). The chromic mud produced by the sewage of the stainless steel pickling is hazardous waste, and the storage, disposal sites and management of which should be designed strictly in accordance with the Standard for Pollution Control on Hazardous Waste Storage. (GB 18597-2001).

(7). Actively study and absorb the Baosteel Corporation’s environmental management experience, and list the ISO14001 environmental management system certification into the entire plant work plan in the early stage of the construction, and establish and improve environmental management rules and regulations according to the requirements of the system, striving for passing ISO 14001 certification at the early commissioning of the project.

23.3 The construction of this project is feasible.

This project, constructed in the Baoshan district of Shanghai, adopts advanced steel-making technology and executes the clean production that after being treated, the emission of exhausted gas is always in line with the standard, and that the discharged exhaust-gas basically has no impact on environment; The wastewater, after being treated and reaching to the standards, is collected into the tail pipe of Shidongkou Wastewater Treatment Plant to be discharged; The industrial wastewater and warm discharged water affects little on the aquatic organism in Yangtze River, and there is no resident sensitive object in the range of 1.3 km. The industrial solid wastes are all treated by means of resource recovery, minimization and harmlessness. The project has such characteristics of clean production as energy conservation, consumption reduction, and low pollution load, in line with the state of technological progress and industrial development policies with the requirements for the construction project. Therefore, this project, by analyzing the environment, is feasible.
Expert Assessment Advises from “Technological Assessment Meeting of the Report on Environmental Impact of Relocation Project of Pusteel of Baosteel Group”

On March 3rd, 2005, the Environmental Engineer Assessment Center in the State Environmental Protection Administration hosted a technological assessment meeting about “Report on Environmental Impact of Relocation Project of Pusteel of Baosteel Group” in Shanghai, totally 38 unit representatives presenting, from Shanghai Environment Protection Bureau, Baoshan Environment Protection Bureau, Baosteel Group, Shanghai Academy of Environmental Sciences, Beijing United Environmental Assessment Company, Shanghai Metallurgical Design & Research Institute and Pudong Iron & Steel CO., LTD of Baosteel Group, in which 8 technological assessment experts (attached the name list below).

Participants visited some spots as the proposed site and the tail water discharge pipe in Shidongkou Wastewater Treatment Plant for discharging wastewater and so on, and construction units introduced them the preparatory work for the project, the engineering and technical characteristics and main content, and evaluation units reported the contents of the Report. After the careful discussion and evaluation, experts’ assessment advises in the technical assessment meeting are as following:

1. General Introduction

For assisting the construction and holding of Shanghai World Expo, Pusteel will be moved from Pudong, the land for Shanghai World Expo, to Luojing in Baoshan.

This project is a relocation and new-built construction. The plot to be relocated for this project is located in south coast of Yangtze river south feeder in Luojing Town, Baoshang District, Shanghai, the north been closed to Luojing bulk dock, the south been facing Beiyunchuan Road, the west been 400 m away from the east of New Chuansha River, the east is to Shigang Road, and occupies 2.82 km². This plot has been approved to be used as industrial land by People's Government of Shanghai Municipality in the document of “General Plan outline of Baoshan area in Shanghai”. This plot has been approved by the Shanghai Urban Planning Administration Bureau in the Shanghai Planning Document No. 595 [2004].

The construction scale of this project is an annual production capacity of three million tons of iron, 900,000 tons of sponge iron, 3.5 million tons of molten steel, 1.6 million tons of heavy plate, 1.4 million tons of steckel.

The major construction contents are:

Main works:
Iron-making Workshop: 2 sets of C3000 COREX furnace;

Sponge Iron Workshop: a set of direct reduction shaft furnace;

Steel-making Workshop: 2 top-bottom blowing converter of 150 tons, 2 LF refining furnace of 150 tons, 2 sets of RH vacuum degasser installation of 150 tons, a electrical furnace of 100 tons, a LF refining furnace of 100 tons, a set of VD refining installation of 100 tons;

Continuous Casting Workshop: 1 set of 400 mm extra-thick slab continuous caster, 2 sets of 250 mm extra-thick slab continuous caster;

Heavy Plate Workshop: a set of 4200/4200 mm heavy plate rolling mill;

Steckel Workshop: a set of 3500/2800 mm steckel mill.

Public Utilities Project:

Lime workshop, oxygen stations, gas-steam combined cycle generating units, steam heat storage stations (using waste heat steam), industrial water supply stations of the entire plant and wastewater treatment station of the entire plant.

Auxiliary Works:

The finished products pier, the stock yard, the energy center, the inspection center, and communications, storage, office facilities etc.

The stock yard will use the existing bulk dock Luojing Port, not to be newly built.

The total investment to project is 17.32 billion Yuan, of which the investment in environmental protection is 1.166 billion Yuan accounting for 6.73% of the total investment.

The Project of Relocation in Luojing will be implemented in two stages.

2. Environmental Feasibility of the Project Construction

(1). The major product in the relocation project of Pudong Iron & Steel CO., LTD of Baosteel Group is heavy plate steel that China is currently short of, in accordance with the requirement of “encourage to increase the supply capacity of plate-tubes and other high value-added steel material in shortage” in the notice of “on Transmitting and Issuing Several Opinions of the National Development and Reform Commission and Other Departments on Curbing Irrational Investment in Steel, Electrolytic Aluminum and Cement Industries”(Decree No.103[2003] of the State Council of the People’s Republic of China). The project construction adopts new Corex iron-making method, directly using lump ore and pellets, without coking and sintering; Steel-making uses 150t top and bottom blowing converter, with the recovery of converter gas accessorially, 100t electric furnace, dust purification accessorially. After the implementation of this project, comprehensive energy consumption per ton steel is 0.582 ton of standard coal, and fresh water consumption per ton steel is 5.67 m³. All of that meet the requirements of
admission conditions of steel and iron investment and construction market. The construction of this project meets the requirements of national industrial policy on technological progress and the development of steel industry.

(2). According to “General Plan of Shanghai”, Baoshan district is the only area for developing the steel industry as a pillar industry in Shanghai. Therefore, it is in accordance with the requirements of the general planning and industrial distribution of Shanghai that Pusteel is moved to Luojing Area of Baoshan. The site selected for the project is planned as the industrial land in the “Outlines of General Plan of Baoshan District Shanghai”, and the new location of Pusteel is therefore in accordance with the industrial arrangement of Baoshan district. The Pusteel’s relocation project meets the requirements of general plan of Shanghai city and Baoshan district.

(3). The project uses large converters, production equipments for making steel by electric furnace and advanced production technologies as Corex direct melting reduction producing molten steel, gas-based direct reduction in shaft furnaces producing sponge iron and others. The various flammable gases are to be recycling, and the remaining gas of production process, is to be used to generate electricity in the gas-steam combined cycle generating units. The steam used for production and life in the entire plant is all supplied the steam produced by the waste heat boiler. In the project, the repeating utilization of industrial water reaches to 98%. In light of the content of “clean production standards-steel industry”(Draft), the design index of this project could achieve the level 1 of clean production. The project construction meets the state requirement on clean production.

(4). The relevant pollution prevention and control measures are adopted to deal with exhausted air, wastewater, solid waste and noise of the project to be implemented, and these measures to be taken are mature and feasible, basically achieving the implementation of emission control.

(5). In the relocation project of Shanghai Pudong Iron & Steel Co Ltd, the discharging amounts of pollutants are: SO\textsubscript{2} of 1446.6 t/a, dust of 1515.4 t/a, COD of 140.3 t/a, petroleum oil of 10.1 t/a and hexavalent chromium of 0.037 t/a. In comparison with the present emission aggregate index in Shanghai Pudong Iron & Steel Co Ltd, in addition to the total SO\textsubscript{2} indicators of 106.8%, higher than the total indicators 91.5 t/a, the rest decreased significantly, in which dust emissions aggregate is only 71.2% of the original aggregate index. The emission aggregate in this project shall be verified further, and be confirmed by the local environment protection department.

(6). After the completion and commissioning of construction, by superposing the background values and predictive values, SO\textsubscript{2}, NO\textsubscript{2} and F\textsuperscript{-} in the typical days of
fall and winter all meet the requirement of standard Class two of environmental air quality; And the winter superposed concentration index of PM\textsubscript{10} in Shangqiao have exceeded the standard, because the monitoring result of PM\textsubscript{10} in winter in Shangqiao did exceed, however the predictive concentration of typical days in Shangqiao, in this project, is only 6.7% of standard Class two of environmental air quality.

The wastewater, after being treated and reaching to the standards, is collected into the tail pipe of Shidongkou Wastewater Treatment Plant to be discharged into Yangtze River, no new sewage outlet added. On the negative hydrological conditions of dry season and neap, discharging tail water into Yangtze River estuary will not form a distinct pollution zone in the waters near the sewage outlet, and affect little on the water quality of sensitive waters as Chenhang Water Source Reserve, far from enough to change the water quality type in the waters. The warm discharging water from CCPP, being discharged offshore, basically will not exert the negative influence on the water quality, water temperature and aquatic organism in Yangtze River.

The predictive result of noise influence indicates that the noises in all plant boundaries, being superposed with the background value, all meet the requirement of standard in daytime and exceed the standards to various extents in nighttime. The surrounding areas of this project are all industrial land or industrial zone, and the distance from the nearest environmental sensitive object to the plant boundary is 1.3 km that the sensitive objects will basically not be affected by the noise.

(7). The assessment unit, by adopting the means of distributing the “Public Survey Questionnaire” on the website of Shanghai Environment Hotline and holding public consultation meetings, carried out the survey with public participation. According to the result of the public survey, 74% of the public are for Pusteel relocation project, and 16% against with the main reason that the living environment quality will be affected due to the possible unsatisfactory pollution control effect. It is suggested that the assessment unit shall further explain the dependability of the environmental protection measures and environmental impact of the project to the public, and then implement the recall Investigation to eliminate the worries of the public. Pusteel companies shall pay attention to the effective operation of environmental protection measures in the process of construction and operation to minimize the impact on the surrounding environment.

To sum up, on the basis of the implementation of the various environmental protection measures in the Report, of ensuring pollutant emission control, and of meeting requirements on total amount control, the construction of this project, analyzing from the perspective of environmental protection, is feasible.

3. On the Compilation of the Report
① The Report, being comparatively standardized compiled, integrates the features of the relocation project, the local environmental characteristics and environmental function zoning, etc., describing clearly engineering and environmental conditions, in which the evaluation method is feasible and the evaluation conclusion is credible on the whole. After being modified and improved properly, it can be used as a basis for project approval.

② Content needed to be revised and improved in the report:

(1). Modify and perfect the project analysis, and make a normalized statistics of the pollution source intensity, including organized and non-organized discharge, the amount of pollution source in a limited time, the discharging amount of every pollution source in detail; add the steam balance in the project; verify the analysis on the standards of pollutant concentration and discharging rate from the pollution sources; explain clearly the amount and quality of each kind of wastewater, and verify the quality of water before and after being treated in the wastewater treatment station that ensure to reach the Class one in the discharging standards.

(2). Improve the appraisal subject of the environmental impact on the construction of the finished products pier, and centralize the impacts of dock construction, operation to surrounding environment and environment, into a subject to discuss, according to the “Specifications for Appraising the Environment of Harbor Construction”.

(3). Complement and improve the appraisal subject. In the subject, complementally explain the ecological condition on the land and in the waters, and analyze the land utilization, river water system and the change of the water surface ratio, and then put forward measures and advises to protect the environment.

(4). Complement the treatment scale, service scope, the destination of tail water discharged and the discharging means of Shidongkou Wastewater Treatment Plant; explain the consistency between industrial wastewater discharging plan in the project and the condition of co-discharge in Shidongkou Wastewater Treatment Plant, and the feasibility and rationality of the plan.

(5). Complement and ensure the calculation of sanitarian protective distance from the pollution source in the project, and its formula; according to the superposed impact of organized and non-organized discharge, ensure the sanitarian protective distance.

(6). On the problem of the exceeding prediction value of noise in plate at night, it is suggested to further reinforce the measures of noise prevention and control, and to verify the prediction value of noise.

(7). According to the result of Public Survey, 16% of people are against the project. It
is suggested that the unit providing advises further explain the reliability of measures on environmental protection in the project, and re-interview and investigate the people concerned to further improve the public participation.

(8). The requirements on the normalized setting of monitoring and sampling in exhaust mast and sewage outlets should be involved into the report complementarily.