

## **A Study on NPPs Environmental Color Design**

**C-w. Lee, J-w. Chang, Y-j. Kim, G-s. Choi**

*Korea Power Engineering Company, INC*

*Ewha Color Design Research Institute, Ewha Womans University*

Corresponding author: Lee, Chul-woo(chally@kopec.co.kr), Kim, Yeon-jung(yeonkim@ewha.ac.kr)

### **ABSTRACT**

We are all running the convenient life in virtue of 'energy' in this technology advanced age. However, the negative recognition that the nuclear power plant is a hazardous facility and distrusts the radioactivity processing facilities becomes the issue. In this study, we not only expect to create the characteristic and environment-friendly image of nuclear power plant, but also we expect to contribute in its believability raising by planning its external appearance color from the viewpoint of environmental color planning so that its external appearance color planning may become the leading model of next generation's nuclear power plant plan.

### **1. INTRODUCTION**

Environment color defines as a part of environmental problem that is related to the color use in view of the socio-cultural dimension while it is not only connected directly in human's survival and peace but also it becomes the necessary element to keep the aesthetic value. The purpose of this study is to implant the positive image for nuclear power plant by giving its stable and environment-friendly image to the local residents as well as raising the pride for working environment in offering the psychological sense of security to the employees through scientific and systematic color planning.

This study researches within the compass of external appearance environmental color planning of the reformed Korean nuclear power plant facility. Study methods are as follows:

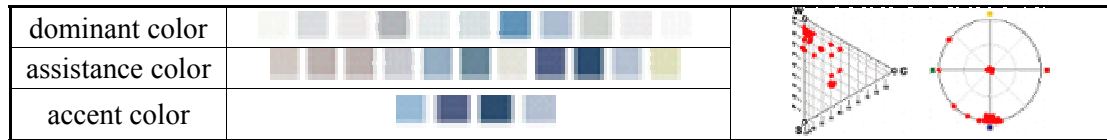
First, this study synthesizes and analyzes the investigation of models for domestic and Japanese nuclear power plant. Second, this study not only investigates and analyzes the existing nuclear power plant color scheme, but also investigates their surrounding environment from the viewpoint of civilization and natural environment in order to extract the environment-friendly color. Third, the researcher visits the power plant surrounding area and executes the questionnaire, and then reflects the results in color planning. Fourth, the researcher chooses the color palette by establishing the basic direction of color planning according to above study results, then suggests three plans that are applied designs passing through the structure conformation analysis process of the power plant building external appearance. Fifth, the researcher analyzes and evaluates the three propositions from the viewpoint of spectacle, ability, construction, maintenance and etc. and then presents the final proposal.

### **2. EXAMPLE INVESTIGATION**

#### **2.1. Japanese nuclear power plants**

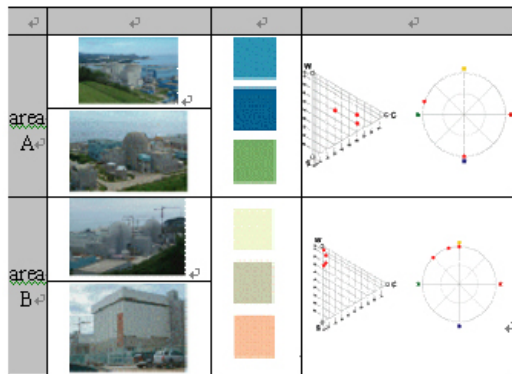
The basic direction of the color planning of the Japanese nuclear power plant is to harmonize with the surrounding spectacle and to use the amenity color that corresponds to the user's request in order to minimize the hugeness and awesome fear of plant facilities.

Synthetically, the color planning direction of the Japanese power plant is using the dominant colors low in chromaticness, high in brightness of YR range and neutral colors. Assistance colors have distinctive feature of middle to low chromaticness and above middle brightness or high brightness. The color harmony relation with its background - the natural spectacle color - is considered important. Therefore, it is mostly harmonious with nature while showing lucid identification. It has the characteristic of hue harmony and brightness contrast effect between the dominant color and the spectacle color.

**Figure 1:** Color analysis synthesis of Japan nuclear power plant spectacle

## 2.2. Domestic Nuclear Power Plants

The cases of domestic power plants analyzed here are mainly located in the East Sea that are at the same location with the plant that the result of this study will be applied. Two examples were analyzed. As for 'Area A', hue is mainly positioned in B range and G range and partially positioned in neutral color range. The main wall of G range is high in brightness and low in chromaticness and

**Figure 2:** Color analysis of NPP spectacle

shows positive effect aesthetically and psychologically, but the dominant color of B range shows visual stimulation in the whole harmony relation due to high chromaticness. As for 'Area B', colors are mainly distributed over GY range in the color circle and mostly positioned near the W-S axis (chromaticness 00-05) in the color triangle. It is distributed over high brightness and low chromaticness that is shown the sense of security, but there is a weak point that may be bored. The nuance of the dominant color and the assistance color are distributed over the high brightness and the hue is distributed over Y, B, G range.

## 3. TARGET SITE ANALYSIS

### 3.1. Target site surrounding environmental color analysis

The target place area is 120.18km<sup>2</sup> where the residing population shows almost no change during the last 3 years. Cultural institutions and facilities are lacking, so raising the cultural image is necessary for the local residents and the employees. Environment-friendly concept application is required as the surrounding area is mainly the agriculture-forestry and semi agriculture-forestry area.

The contents are summarized as follows (Table 1):

exterior	adjacent existent power plant		
	office building		
surrounding environment of power plant	surrounding environment of power plant		
	distant view of nature		
	near view of nature		

**Table 1:** The environmental color analysis of the adjacent plants

## 4. QUESTIONNAIRE

### 4.1. Questionnaire outline

The questionnaire was executed to the inhabitants dwelling in the area of the power plant and to the working staffs. Sample numbers were 110 inhabitants and 80 staffs. The questionnaire was executed and analyzed in October 2003. The purpose of this questionnaire is as follows:

First, the purpose is to give positive image of the new constructed power plant and contribute to raise the power plant believability by inducing participation of the local inhabitants. Second, the purpose is to examine the local inhabitants' awareness about the environment and to search the image of color environment that dwells in their consciousness. Third, the purpose is to collect the evaluations and opinions of the local inhabitants on the nuclear power plant. Fourth, the purpose is to reflect the staffs' evaluations and opinions of their working environment in the environment-friendly color planning, and eventually contribute to raising the image of the power plant.

### 4.2. Questionnaire results

After investigating the questionnaire, the color palette was analyzed synthetically as follows:



**Table 2:** Color palette analysis after investigating the questionnaire

## 5. COLOR PLANNING

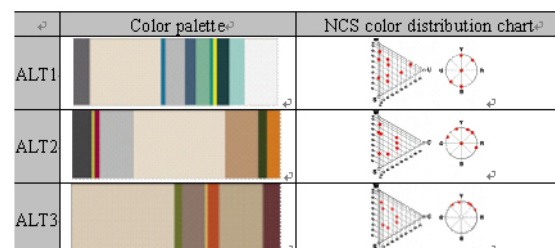
### 5.1. Outline of color design

The basic direction and target of power plant color planning were established as follows: First, it is to ensure an environment-friendly image of the power plant. Second, it is to produce a human-friendly working environment. It not only improved the working environment by solidifying communication in the application of agreeable and orderly design, but also strengthened the sense of belonging through the identity security. Finally, it strengthens the aesthetic specialty. In order to raise the aesthetic specialty of whole environment and to apply the objective and scientific harmony theory, it applied the harmony principle based on Biren's 'Color Triangle' and the color harmony principle of Chevreul's 'Harmony Principle of Resemblance and Contrast'.

### 5.2. Color palette proposal

Through the above study method and process, three alternatives of color palettes are proposed. As for 'Alt 1', the high brightness warm gray was selected as the dominant color to accommodate the four seasonal color variations and to apply human-friendly and environment-friendly color. In the case of chromatic color, chromaticness 20 was used to show identical chromaticness harmony relation(Ostwald's Harmony Theory) while blue and green colors were used in harmony with the hue of the existing power plant. As for 'Alt 2', high brightness color of YR range was chosen as the background color. It applied the unambiguous principle among Judd's harmony theories so that it makes contrast in relation with the dominant color.

As for 'Alt 3', we extracted the color from the sand of nearby area for the dominant color that occupies a wide area. Color of YR range, which is suitable in four seasons, was applied and the

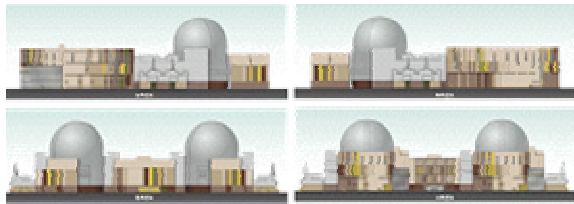


**Table 3:** Alternatives proposal of color palettes

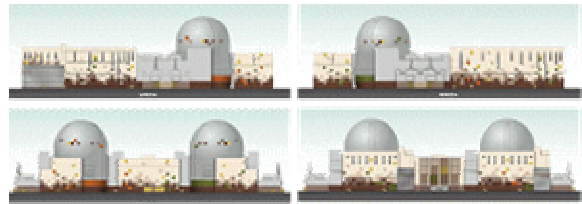
assistance color range that was extracted in the nature color has the relation with the harmony of equal blackness (Blackness 60/Ostwald's harmony theory) and has the harmony of different hue in the hue relation. Generally the colors are extracted from soil and plant, mainly showing chromaticness 30~40 and middle brightness. The results of the questionnaire also showed preference of color that is environment-friendly and harmonious with the surrounding environment. This alternative was adopted as the final proposal through the presentation of the service ordering authorities and the enforcement company.

### 5.3. Presentation of design application proposal

The external appearance of power plant building is the geometrical solid figure of hexahedron, sphere, cylinder and etc. Such geometrical forms imply order and give stable feeling. But according to the result of the questionnaire, the coercive building shape and monotonous color were exposed to controversial point. At the same aspect, the huge volume of the mass and the cold impression of the exterior material give the rejection feeling. Therefore, the design, which is harmonious with the environment-friendly color, strengthens the connection between the physical function of power plant facilities and the color function



**Figure 3:** Alt 1 proposal of design application



**Figure 4:** Alt 2 proposal of design application

### 5.4. Synthetic analysis and evaluation

Above design results were compared with each other as below table. All of the alternatives are suitable in the functional aspect such as psychological stability and recognition as well as in the spectacle aspect that is judged visually such as change, stability, and ensuring the identity of the power plant. Alt 1 and Alt 2 are superior in the aspect that it dissolves the coerciveness of huge mass through alteration and segmentation. Alt 1 has advantage over others in the aspect of workability and painting quality of the turbine building. All two are the same about building maintenance. Synthetically, all two alternatives were in the design aspect, but Alt 1 was evaluated the most superior to other in the aspect of construction attribute. Thus, Alt 1 was selected through final discussion with the ordering authorities and the enforcement company.

## 6. CONCLUSIONS

This study was about the exterior color planning of a nuclear power plant in view of the environment color planning. Through this, we hope to contribute in gaining reliability of the nuclear power plant and creating a environment-friendly image. The contents and results of this study are expected to be introduced to preservation and administration of existing power plants and also become the leading model of the nuclear power plants to be built in the future.

## References

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