Application of welding simulation training system

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Abstract: The situation of the reverse distribution of energy resources and load center in China determines that UHV transmission technology has a wide application space in China.[1] With the increasing size of UHV transmission line construction, the application of welding technology for UHV steel tube tower is becoming more and more important, and the training of welding technology is accompanied by the use of a large number of consumables. China vigorously promoted the research and construction of AC and DC transmission technology in order to ensure the optimal allocation of energy resources in a large scale.[2] In order to further save the cost, this paper combines the increasingly mature virtual reality 3D technology, and applies the simulation training system to the system. In the training of MIG (MAG) welding skill of power grid steel structure, the characteristics and training flow of welding simulation training are introduced, and the application effect of the simulation training system is summarized. By constantly exploring new welding training mode, improving the shortcomings of traditional welding training and improving the overall training effect of welding workers.

1. Introduction
In recent years, the pace of power grid construction in China has been accelerating, and the demand for welding workers in domestic tower manufacturing enterprises is increasing. This makes the training of welding operators more and more intensive, and puts forward higher requirements for welder training quality. The traditional welding skills training has consumed a lot of manpower and material resources because of the high cost of material consumption, the difficulty of operation, the long training period and the pollution to the environment. With the growing maturity of virtual reality 3D technology, it is applied to the teaching of welding practice, so that the welder can be trained under the guidance of "virtual teacher" in the intelligent welding training room, and gradually improve its own operation skills. At the same time, it can effectively improve the efficiency of training, save training costs and reduce environmental pollution.

2. Characteristics of welding simulation training
The MIG (MAG) "welding simulation training system" is mainly composed of five key parts: working table, processor, touch screen, 3D virtual reality mask and ergonomic welding gun. After the system starts, it collects and calculates the values generated in the welding process, analyzes the actual operation of the welding. Beginners do not have to have any welding skills, through the system created "virtual reality" working environment, the use of realistic "welding gun" on the "workpiece" on the exercise, thus complete the complete set of skills training courses. Moreover, the simulation welding system enables the operator to have absolute safety in vision and operation. In the "virtual reality world" created
by the system 3D goggles, although there are arc burning, metal splash, metal molten pool and other scenes, the accident will never be caused by the operation error, and it will not harm the human body. Compared with the real welding environment, smoke and harmful gases will not be produced. The welding simulation system is shown in Figure 1.

3. Application of welding simulation training
According to the welding training and assessment rules for the steel structure of the power grid, the typical training projects have two kinds of horizontal rotating tube and 45° plate butt welding, and the corresponding form of welding joint is chosen, and the training subjects for the docking of horizontal rotating tube and plate in the welding simulation system can be trained for the training of the welding position, such as flat, vertical, horizontal and pitching. During the operation, the trainees wear virtual reality helmet and handheld welding gun. According to the same operating procedures and specifications as the actual welding, the complete operation process of starting arc, arc, moving and the finish moving. In the process of welding, according to the different variables controlled by the operator on the weld pool, the 3D eyepiece in the virtual reality helmet is used to create a real welding environment so as to achieve the purpose of improving its welding skills.

3.1 Welding simulation training process
Welding simulation training is divided into three stages: basic training, advanced training and simulation welding:
(1) Basic training stage: this model is suitable for beginners with no welding base. The training mode is "simulation virtual teacher (overlapping image)" as the operation guidance, demonstrating the best parameters that they should keep in training. The trainees are fed to the trainees with the feedback of red, green, yellow image transformation and simulated welding, indicating whether the specifications of the welding operation are correct, so that the trainees can correct them immediately. Combined with the actual welding skills training, it is divided into the welding speed practice, the correct distance of the welding gun and the workpiece (the length of dry extension), and the appropriate welding torch angle practice. The basic training mode is shown in Figure 2.

Figure 1 welding simulation terminals and 3D mask
2) The advanced training stage: after the basic mode training, the trainees have developed the correct habit of the welding gun dip angle, the length of dry extension and the welding speed in the welding process. At this time, the trainees can be trained in the advanced mode. In the advanced mode, the system has different weld joint forms, such as "T type joint", "butt joint" and so on. There are "four steps" and "two steps" for the trainees to choose according to the operating habits. The trainees can choose the target specification to practice according to the training needs.

3) Simulation welding stage: when the trainee receives an advanced training for a period of time, the trainee can enter the simulation welding stage. This stage will not guide the "virtual teacher (overlapping image)". The trainee can set the welding parameters (current, electric pressure, arc, arc and so on) according to the operating experience. The training will be conducted in a virtual "virtual" environment. When the whole subject is completed, the training results can be generated through systematic comprehensive evaluation. Moreover, the trainee can also check and correct the errors in the welding process in time. This stage is conducive to the further improvement of the welding level of trainees. The simulation welding stage is shown in Figure 3.

3.2 Application effect of welding simulation training
The welding simulation training system is applied to the welding training process of power grid steel structure, compared with the traditional training mode, it has certain superiority.

(1) Economy: by adding simulation training courses in the actual welding operation training process, the training cost can be greatly reduced. Through the practice training of recent years, it is proved that the metal materials and resources consumed in the traditional welding training process (including electricity and consumables) can save about 25% of the training cost, as shown in Figure 4.

(2) Interactivity: the operation interface of the welding simulation system is simple. The number of helpful information for the trainee is large, the human-machine interface is friendly and has the navigation function. When the personnel use the "welding simulation training system" for welding training, the trainees can choose the corresponding training subjects through touching the screen, and train the "virtual reality world" created by the 3D imaging system. The navigation interface is detailed in Figure 5. Besides, the system has more knowledge of welding theory, which helps the trainees learn.
4. **Summary**

(1) Welding simulation training is the start of practical training, and a powerful complement to practical teaching. Through the simulation welding pre training, the trainers can adapt to the actual welding environment as soon as possible, and enter the practice training stage with the standard welding operation. This will greatly save the training cost and shorten the training cycle.

(2) The welding simulation training is not a real operation to the equipment, and it also has the irreplaceable limitation. Especially, the difference between the quality and the feedback of the welding gun and the real working environment is the key link to be improved. After the welding simulation training, the practice training process can not be completely thrown away, the practice and the "virtual reality" training should be improved and used alternately.

(3) With the continuous progress of science and technology, the inheritance of welding skills should not always stay under the traditional training mode of "teachers with disciples". Seize the opportunity brought by the development of science and technology, introduce simulation virtual training at the right time, continuously improve the training efficiency, and continue to innovate and try new welding training mode.

**References**

[1] Liu Zhenya. China electric power and energy [M]. Beijing: China Electric Power Press, 2012. 161-161

[2] Liu Zhenya. Global energy Internet [M]. Beijing: China Electric Power Press, 2015. 48-48.