

The Study of the Determination of Subjective Vibration Velocity Rating of Main Transformer under operating in Nuclear Power Plant

Wook-Ryun Lee, Jun-Shin Lee, Byong-Han Kim, Sang-Kil Lee, Sang-Guk Lee
Korea Electric Power Research Institute, 103-16, Moonji-Dong, Yoonsung-Gu, Daejeon, KOREA

1. Introduction

Main transformer's integrity assessment in nuclear power plant is estimated by the electrical test of electrical core and wire and the chemical analysis of insulating oil. Mechanical test or analysis has not been so far. So this study makes it with the vibration velocity rating.

The vibration velocity ratings in main transformer that is based on the real data from vibration velocity measurement under operating and other machinery vibration code such as ISO code is renewed.

2. Methods and Results

2.1 Background

Main transformer in nuclear power plant had brought the accident of total 32 times from 1978 to 2002 such as plant shutdown. As the analysis of the accidents is given in table 1, they are classified into electrical problem, chemical problem and mechanical problem. Among them, mechanical problem is about 40%. And one half of mechanical problem or more is related to vibration.

Therefore we have studied vibration velocity ratings of main transformer for precautionary measures and evaluation criteria.

Source	Contents (No.)	Total	Test
Electrical Problem	- natural disaster(1) - coil burned (2) - personal mistake(2) - accident of electric power transmission system related (1) - instrument error (4) - bad design(1) - bad parts(1) - aged problem(1)	13	Insulation Diagnosis Test
Chemical Problem	- oil burned(1) - impurities in coil(1) - bad goods(1) - the increase of combustible gas (3)	6	Insulating Oil Analysis
Mechanical Problem	- bad design(1) - bad parts(1) - parts' corrosion(3) - bad connection in contact surface(3) - expansion, wear & crack (5)	13	

Table 1. The analysis of the accidents of main transformer in nuclear power plant from 1978 to 2002

2.2 Data of Measurements of Vibration Velocity

The main transformers of all the nuclear power plants in Korea were measured for vibration velocity data under operating. Each main transformer was measured from 16 to 40 points by 1~2 meters apart in one side, see figure 1.

As a result of measurements, figure 2 is shown. The total average vibration velocity of them is 3.48 mm/sec and the average vibration velocity of maximum vibration velocity of them is 17.4 mm/sec. But it is 10.4 mm/sec if except the value of partial resonance to enable to take follow-up maintenance.

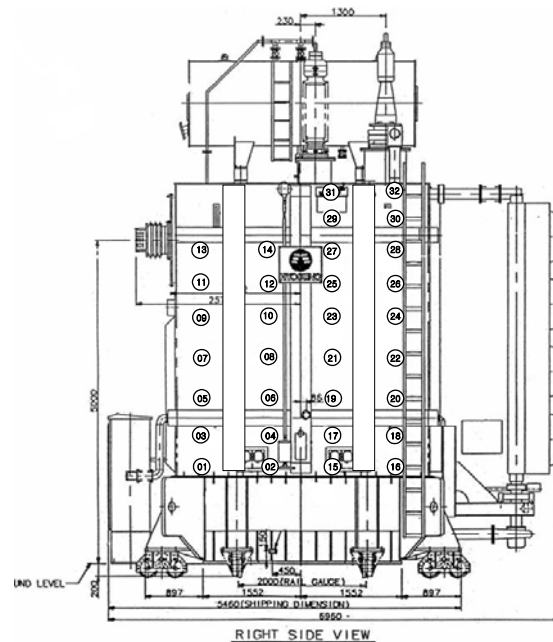


Figure 1. Measuring points on single phase main transformer

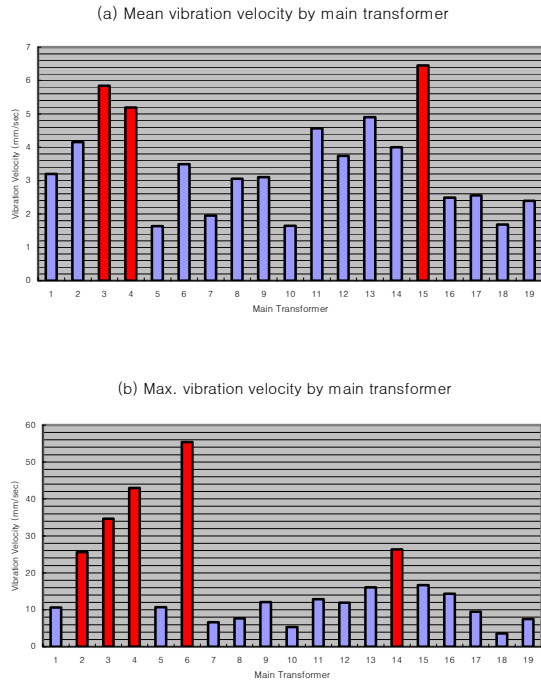


Figure 2. Vibration velocity by main transformer in nuclear power plant.

2.4 Vibration Velocity Rating

A rating system for the vibration velocity of main transformer is shown in figure 3 to form a common basis for comparison. Several components of vibration at different frequencies may acceptably exist at the same time, each one at the allowable limit for that frequency as determined from the curves. And then figure 4 gives the subjective grade of vibration velocity. Therefore table 2 determines the state of main transformer.

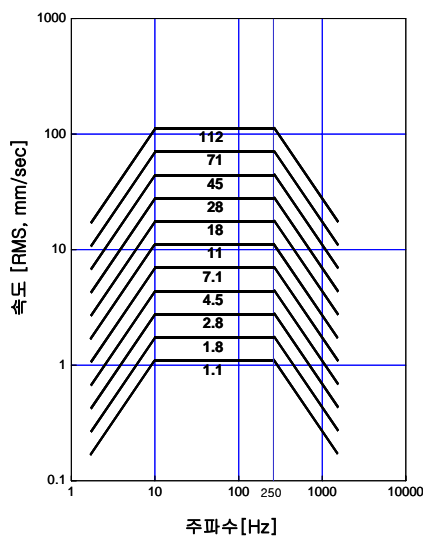


Figure 3. Velocity rating curves in narrow band (The curves decrease from 10 Hz and 250 Hz at 20 dB

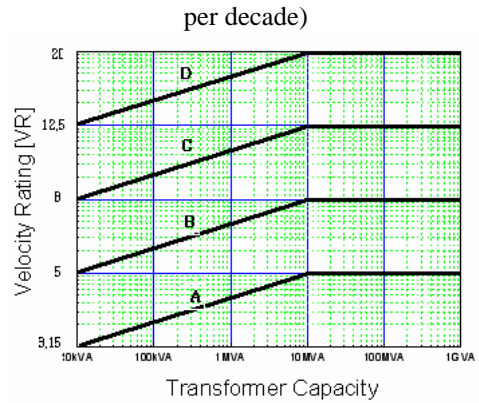


Figure 4. Subjective velocity ratings by transformer capacity

Grade A	Grade B	Grade C	Grade D	Grade E
GOOD	←————→			BAD

Table 2. Vibration velocity ratings grade

2.5 Results of vibration velocity ratings

Grade	A	B	C	D	E
No.	1	4	5	4	5

Table 3 gives that the vibration velocity ratings are applied to measuring data

Five main transformers of grade E are confirmed to the partial resonance. Now they are solved or ready to be solved.

3. Conclusion

Vibration velocity ratings of main transformer can give precautionary measures and evaluation criteria to manufacturer and purchaser.

REFERENCES

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