

An Evaluation of the Physical Environments of a Nuclear Power Plants for Human Factors Review in Periodic Safety Review

Dae Ho Kim and Yong Hee Lee

Instrumentation & Control · Human Factors Division, Korea Atomic Energy Research Institute, Daejeon, 305-600,
Email: daeho@kaeri.re.kr

1. Introduction

Currently, operation of a nuclear power plants(NPP) is highly emphasized by the integrity of the H/W and the human factors security, so the periodic safety review(PSR) is performed to NPP. The PSR activities on human factors include physical environments (illumination, noise, vibration, temperature and humidity etc). The review on these physical environments is to verify the possible affect to the human error during the operation of the man machine interface. Physical environments affect the health, job stress and job satisfaction of NPP's employees. On the ground of the reason, we need integrating the management program for the sufficient satisfaction of the regulatory basis and standards of physical environment and considering a health, a job stress and satisfaction of NPP's employees. So, this paper describes the planning of the setup procedures of physical environments and the adequate management program for the field applications in NPPs.

2. Management Program of physical environments for human factors

The management program factors of NPP's physical environment consists of three phases (reviewing physical environments, examination of health, and checking job stress influences) in the physical environments of NPP. Figure 1 is a management procedure of physical environments.

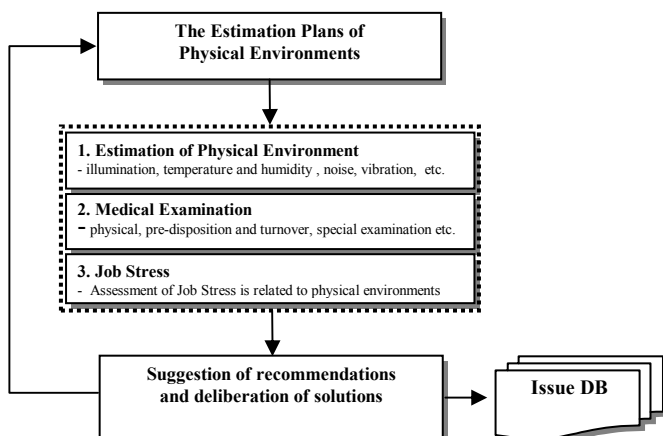


Figure 1. The suggested procedure for the management of physical environments in NPPs

The management program of the physical environments should be meet the requirement of the domestic regulations of the nuclear and the industrial safety and health etc., and international technical codes

and standards. And we considered the health aspects, the job stress and satisfaction of NPP's employees too.

2.1 standards of physical environment

A physical environments include illumination, noise, vibration, temperature and humidity, velocity, atmosphere (dust, gas) etc. A technical standards and regulatory basis of NPP's physical environments are referenced NUREG-0700 Rev.0 (1981), Rev.2(2002)[5], Human Factors Design Handbook(Woodson)[6], KS (Korea standard) codes, the act of industrial safety and health.

2.2 A management of a health for NPP's employee

A management of a health in the NPP's employees secure prevention a human error by relating human factors of psychological and physical fatigues, and drug abuse, etc., and check human resources conditions. Activities of health management include a medical examination (an early periodical diagnosis (physical examination), pre-disposition and turnover of employee, an early periodical diagnosis, and special examination), mental health and drugs(including alcohol), the promotion of health management.

2.3 A manage of job stress

Job stress comes about interaction between a worker and the job requirement [1-4]. Job stress represent mismatch between a personal tolerances of characteristics and the information requirement and workloads for duties and tasks in special job requirements and inadequate physical environments. A direct factor of job stress is composed of job characteristic, organizational and physical environmental factors. Physical environments factors of this study are represented table 1.

Table 1. Job stress factors of physical environments

physical environments factors	
illumination	visual power, work performance
temperature/humidity/ velocity	high/low temperature stress level, air conditioning system
noise	auditory capacity, work performance contradiction of a sound and vibration level, tension of muscle
vibration	
atmosphere(dust, gas) etc.	air pollution, ventilation
spaces/positions of working sites	position of material, co-work, tolerance spaces, convenient facility

The factors are composed by the 6 main factors (illumination, temperature/humidity/velocity, noise, vibration, atmosphere (dust, gas etc.), and spaces/positions of working sites), and totally 14 factors.

3. A case study

3.1. Evaluation of physical environment

A measurement of physical environments is followed by methods of domestic and international standards. Effective values of a measurement of physical environments are influences of performances and health in working condition. Figure 2 show the point and formations of a measurement of physical environments for MCR and local working conditions.

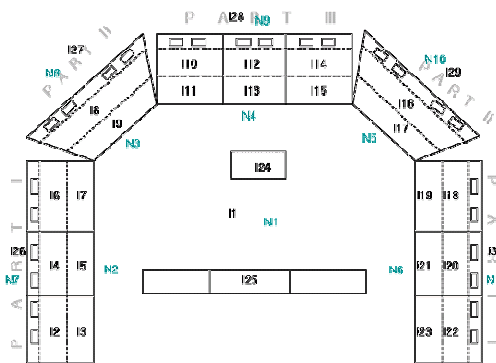


Figure 2. The measurement formations of physical environments

3.2 Management of the health

1) A medical examination

Total health examination program are composed an early periodical diagnosis and a special medical examination. Total health examination programs satisfy the regulatory conditions that include medical examination's item, and at the time of the examination (pre-disposition and turnover of employee, an early periodical, and special examination).

2) Examination of mental health and drugs

Examinations of mental health have the use of technical methods for psychological diagnostic technique (SCL-90, CIDI, etc) and medical interviews of a specialist in problem of mental. A examinations of drugs include AMP (Amphetamine), BZO (diazepam, lorazepam, benzodiazepines), BAR (phenol-barbital, pentobarbital, barbiturates), COC (cocaine), MET (methamphetamine), OPI (morphine, heroine, codeine), and THC (tetra-hydro-cannabinol, cannabinoids, marihuana).

3) An activity of health improvements

The latest issue of health improvements prevent from hazardous working conditions are Musculoskeletal Disorders (MSDs) and disease of angiocardiology. A management programs of health are solved this issue of health improvements.

3.3. Result of a job stress study

We chose 427 procedures that are related to safety out of 777 officially managed procedures referenced by 13.5 of FSAR. We finally chose 70 procedures regarding the duties for NPPs' division, experiences of operations, an operational know-how, and the indication of operational weakness. The reliability by Chronbach's Alpha model of this methods show 0.8898. Figure 3 is the results of job stress assessment

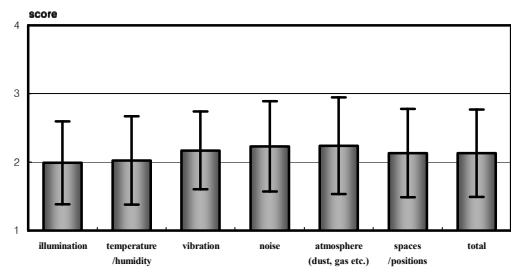


Figure 3. A result of the job stress assessment

4. Discussion

The management program of the physical environments can characterize the NPPs. Also required are the employee's health and the comfortable environments. The results of the periodical evaluation of the physical environments should be integrated into the program's database in order to support the task analysis and the job stress assessment in NPPs.

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