

# Human Factors in PSR(Periodic Safety Review) of Nuclear Power Plants

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## 1. Introduction

Recently established enforcement regulations of PSR(Periodic Safety Review) demand execution of periodic review that failure problem related in safety of current NPP(Nuclear Power Plants). Basic condition defining evaluation range of this study is based on "the detail content of periodic safety review," enforcement regulations 19-2 of the Atomic Energy Act, and also refer to "Periodic Safety Review of Nuclear Power Plants," IAEA Safety Standards Series[2,3,4].

The assessment of this study is to verify management condition of human factors affect safety operating NPP. To ensure safety for human factors, we assess that shift work, overtime work, health, task, qualification of employee, duty for at all time, training, training in simulator, etc. We then include assessment application of educational experience by employee and recent international research.

## 2. Human factors in PSR

Assessment aim of human factors in PSR ensures whether the failure problems related in safety of current NPP are happen or not? IAEA Safety standards series define assessment criteria of human factors for safety review that table 1. Basic condition defining assessment range of this study is based on enforcement regulations and recent international technical reports(ANSI 3.1, 3.2, 3.5)[1]. And we also refer FSAR(Final safety analysis report) of PSR's object of NPP. Basic assessment main factors for checking management status of human factors are working conditions, qualifications, training of employee. Employee appeared in the organization charts of NPP are subjected to PSR. Assessment content is to check the safety problem of human factors. And their satisfaction assessment of human factors is to ensure safety and health of employee.

## 3. Assessment criteria of human factors

### 3.1 Working condition

Table 1. Assessment factors of Human factors

IAEA Safety standards series	The Atomic Energy Act
(a) Staffing levels for the operation of the nuclear power plant recognizing absences, shift working and overtime restrictions.	(a) Staffing levels for the operation of the nuclear power plant recognizing absences, shift working and overtime restrictions.
(b) Availability of qualified staff on duty at all times.	(b) Availability of qualified staff on duty at all times.
(c) Policy to maintain know-how of the plant staff.	(c) Programmes for initial, refresher and upgrade training, including the use of simulators.
(d) Systematic and validated staff selection methods (e.g. testing for aptitude, knowledge and skills).	(d) Information demand and workload of staff
(e) Programmes for initial, refresher and upgrade training, including the use of simulators.	(e) Man-Machine Interface
(f) Training in safety culture, particularly for management staff.	
(g) Programmes for feedback of operating experience for human performance failures/errors that contribute to safety significant events, and of their causes and corrective actions.	
(h) Fitness for duty guidelines relating to hours of work, health and substance abuse.	

Working condition is assessed according to the situations of normal and emergency work situations include O/H periods. It is classified into general working and job condition, health condition and operation experience of employee, that is, its assessment consist general management level of employee.

1) *Management of work*: Meaning of working conditions is general work operation requirement. Management of work includes working attitude, shift work, representation of work system and schedule.

2) *Job condition*: Job condition factors include job stress, job satisfaction, job commitment, and motivation of employee.

3) *Management of health*: A health factors is to observe management of obligation index for health, include drugs and alcohol abuse. Assessment factors for health are periodic medical examination of employee, planning for health improvement, level of fatigue, body condition, and smartness.

4) *Operation experience of employee and recent research result system*: An operation experience of employee and recent research result factors include maintenance record and up to date of document, collection and estimation of operation experience of employee reflection results of redesign and operation experience of employee, and Error report system

### 3.2 Qualification

Qualification management of employee verifies the qualification of employee and experiences in the fields of their duties at all times. Qualification management consists of recruit, the degree of employee's qualification, and the application content of employee's know-how and human errors.

1) *Recruit*: A recruit factor is to verify propriety of recruit condition that include professional, adequate of task and job.

2) *Qualification of employee*: Qualification of employee is to compose requirement of qualification for operating NPP, technical license, and completion of an

essential training course. This include that the present condition of operating license, assignment of employee criteria based professional, license, and a number of regular staff and method of fill up a vacancy.

3) *Application content of employee's know-how and human errors:* This factor is application of operation experience of employee and recent research result. It is application content of employee's know-how and human errors.

### 3.3 Training

Training program is scheduled and executed for training of basic, refresh, and upgrade of employee in NPP. Training factors consist of training program, safety education, training of simulator, and training application of educational experience by employee and recent international researches.

1) *Training program:* The assessment of these factors is systematic training course and teacher for technical skill by training program. Systematic approach to training assesses training of basic, refresh, and upgrade of employee in NPP.

2) *Safety culture:* Education factors of safety culture for staff in the NPP are to assess execution condition for top manager and supervisor.

3) *Training by simulator:* The assessment factor of training by simulator are consist training program and appropriate simulator for training.

4) *Operation experience of employee and research results the adaptation of training:* Application of operation experience by employee and research results is adapt training and feedback for training course.

### 4. Assessment procedure of PSR

The assessment procedure for human factors consist of the stages such as establishing essential assessment factors, document base assessment, field survey and

assessment, and expert assessment. As an assessment method, document-based assessment is compared with documents of plants and essential assessment criteria. Field survey and assessment method are to verify the document based. Expert assessment method is to perform a question under consideration. We use the compose panel of human resources and human factors' expert for ensuring the object of assessment. Each stage are repeated, the review documents resulting from the performance results are kept in regular documents and database. Therefore, the method for safety improvement is suggested. The satisfaction status of the detailed factors uses the checklist like table 2.

### 5. Conclusion

The assessment of human resources in PSR have to be evaluated as an integrated method which links the other human factors such as MMI (man-machine interface), and the aspect of organization administration. So, human factors maintain the correlation to other factors of safety by affect.

### REFERENCES

- [1] ANSI/ANS-3.1: Selection, Qualification, and Training of Personnel for NPP, 3.2: Administrative Controls and Quality Assurance for the Operational Phase of NPP, 3.5: NPP Simulators for use in Operator Training and Examination
- [2] IAEA, Safety standards series, "Periodic Safety Review of Nuclear Power Plants," (DS 307, Draft 9, 2002-05-02)
- [3] IAEA, Safety standards series, "The operating organization for nuclear power plant," Safety guide No. NS-G-2.4.
- [4] IAEA, OSART Guidelines 1994 Edition.

Table 2 checklist for assessment of shift work (example)

Criteria	Inspection items	Inspection lists(field data)	Content of checklist
Working condition (normal condition/ abnormal condition)	Management of shift work	- Regulation of company The power generation department : regulation of operation maintenance	Is the composition of the shift considered for training, holidays, disease, etc? Is working time observed?(except shift required time)
	1. Shift work (working time of shift, over time, rest time, holiday & weekend, compensate for money, etc)	The general affair department: regulation of emergency work The labor department: night duty point, regulation of pay, detail enforcement regulation of pay	1. The work of continue 16 hours overtime 2. The work of 24 hours overtime per discretion 28 hours 3. The work of 72 hours overtime per discretion 7 days 4. Is the cause authorized adequately by document type in special case that break of previous contents (1, 2, and 3 mentioned above) of checklist?
	2. Technical aid for emergency situation of shift work	The personnel affair department: regulation of personnel	5. Is organization of power generation and schedule considered for minimum of happening special case? 6. Is fatigue of employee considered for 12 hours overwork?
	3. Human factors of shift work (safety insurance, assessment of fatigue)	management -Standard conduct(operation03, operation04)  - Field data Dairy of overtime work Dairy of the safety and power generation department) - INPO 84-008 (Rev 0), regulation of work shift	7. Is smartness, physical condition, fatigue of employee assessed on duty? 8. Is schedule of back shifts, weekends, and holidays managed? Is money compensated for night shift work? - Ensure general work/night shift work money compensation Is engineering, technical investigation, and aiding system prepared for safety problems of shift work? Is communication system of plants prepared in emergency work? Is fatigue assessment and management for safety secure prepared while shift work? Are drugs and alcohol factors managed for interfering with staff's general work? Is normal condition staff operated through diagnose of drugs abuse and mental trouble?