

# Study on relationship of performance shaping factor in human error probability with prevalent stress of PUSPATI TRIGA reactor operators

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**Abstract.** Human factor can be affected by prevalence stress measured using Depression, Anxiety and Stress Scale (DASS). From the respondents feedback can be summarized that the main factor causes the highest prevalence stress is due to the working conditions that require operators to handle critical situation and make a prompt critical decisions. The relationship between the prevalence stress and performance shaping factors found that  $PSF_{Fitness}$  and  $PSF_{Work Process}$  showed positive Pearson's Correlation with the score of .763 and .826 while the level of significance,  $p = .028$  and  $p = .012$ . These positive correlations with good significant values between prevalence stress and human performance shaping factor (PSF) related to fitness, work processes and procedures. The higher the stress level of the respondents, the higher the score of selected for the PSFs. This is due to the higher levels of stress lead to deteriorating physical health and cognitive also worsened. In addition, the lack of understanding in the work procedures can also be a factor that causes a growing stress. The higher these values will lead to the higher the probabilities of human error occur. Thus, monitoring the level of stress among operators RTP is important to ensure the safety of RTP.

## 1. Introduction

Based on past nuclear accident cases, human error is said to be the main cause for accidents in nuclear power plants. However, it is also associated with other factors such as less effective training, complicated procedures and also natural disasters. These factors have resulted additional pressure or stress on operators in nuclear power plants. If nuclear plant operators have a high and complete engineering knowledge to operate technology systems, it will definitely help to reduce the risk of undesirable accident.

The subject of human factor is very important to reduce the risk of nuclear accidents. One of the methods to study human factor is through a Performance Shaping Factors (PSF) based on the standardized Plant Analysis Risk-Human (SPAR-H) method. Lesson learnt from nuclear power plant can also be applied to nuclear research reactor. This study was conducted on the factors of human performance shaping factor, accident sequence analysis, and probability of human error. Human performance shaping factors are factors that affect the probability of human error as considered in the



analysis of human reliability such as the level of training, quality or the existence of procedural guidelines, the time available to perform the action and others.

According to the Department of Occupational Safety and Health, JKKP Negeri Johor (2011), there are four major elements related to industrial accidents in Malaysia namely employers, laws, machinery machines and workplace environmental factors. However, most employers often overlook the environmental factors in the workplace as it is considered a trivial problem. In these workplace environmental factors, stress or stress problems, uncomfortable working conditions, ventilation systems, inadequate lighting and ergonomics are hidden problems that will lead to chronic health problems and consequently will result in accidents that not only endanger them but also affecting other employees, the public and the environment.

The Quality of Worklife (QWL) module was developed by the National Institute of Occupational Safety and Health (NIOSH) or better known as the Occupational Health and Safety Institute to measure the symptoms and causes of stress in the workforce industry. Whereas DASS is a set of three self-report scales designed to measure the negative emotional state for depression, anxiety, and stress used in this study to quantify the prevalence stress. Since each operator reacts differently to the same case given, the prevalence stress is chosen as individual factor that contribute to individual HEP. The main scope of this study is to find out any significant correlations between prevalence stress and PSFs

## 2. Method

The design of the study is a survey method that uses quantitative approaches to gather information to achieve the objectives of the study. The survey method can be defined as the acquisition of information directly from a group of individuals by submitting a question via a questionnaire.

In this study, the SPAR-H worksheet was used to assess the performance shaping factor (PSF) for each respondent. Then, using the Depression, Anxiety and Stress Scale (DASS) form and the Quality of Work Life Module (QWL Module) were used to evaluate prevalence stress level, identify and analyse the causes and factors that cause worker's prevalence stress.

Respondents were eight RTP operators who also involved in RTP maintenance work. Respondents usually involve in the daily inspection of RTP known as early morning checklist activity and after-hours checklist activities.

All data from the SPAR-H worksheet will be analysed to obtain the value of the performance shaping factor (PSF) for each operator. Subsequently, human reliability can be seen from the probability of human error (HEP). In the survey form, all data and information will be analysed using the Social Science Statistics Package (SPSS) software. This analysis is used to identify factors that influence the prevalence stress among RTP controllers and identify the correlation relation between prevalence stress and performance shaping factors (PSFs).

## 3. Results and Discussions

SPAR-H worksheet enables the  $HEP_{Action}$  to be predicted between respondents based on the condition imposed on the case study. Table 1 shows the value of  $HEP_{Action}$  for this case study.

**Table 1.** Human Error Probability.

Respondent	HEP (Action)
1	1
2	0.0013
3	0.0005
4	0.0040
5	0.0200
6	0.0020
7	0.0100
8	0.0050

It was found only respondent 1 would definitely fail to perform correction task to the given for this case. This is due to the fact that the respondent 1 has assessed PSF<sub>Procedures</sub>, PSF<sub>Fitness</sub>, and PSF<sub>Working Process</sub> with higher score than most of other operators. One of the most stand out factor for this operator was due to the lesser amount of service at RTP compared to other operators. Thus the respondent 1 has lesser time and exposure to perform such Initiating Event selected for this study. This also help to explains why the respondent 1 select a higher score for PSF<sub>Working Process</sub> because the respondent still could not completely comprehend all the RTP working process. Other respondent's probability of error was found with different values. This variety is due to different values were chosen for the all 8 PSFs based on the respondents choices. The different background the respondents may effect different values for PSFs chosen that results such HEP<sub>Action</sub>.

Out of many background factors, Prevalence Stress was chosen to identify whether there are any correlation with the eight of the Performance Shaping Factor (PSF) that contributed to HEP<sub>Action</sub>. The relationship of PSF for HEP<sub>Action</sub> with Prevalence Stress is shown in the Table 2 below.

**Table 2.** Correlation of Performance Shaping Factors and Prevalence Stress Measured from (DASS).

PSF	Values
Time	Pearson Correlation .022
	Sig. (2-tailed) .958
Stress	Pearson Correlation -.455
	Sig. (2-tailed) .257
Complexity	Pearson Correlation -.482
	Sig. (2-tailed) .227
Experience	Pearson Correlation .285
	Sig. (2-tailed) .494
Procedure	Pearson Correlation .740*
	Sig. (2-tailed) .036
Ergonomics	Pearson Correlation .520
	Sig. (2-tailed) .186
Fitness	Pearson Correlation .763*
	Sig. (2-tailed) .028
Working Process	Pearson Correlation .826*
	Sig. (2-tailed) .012

Only  $PSF_{\text{Fitness}}$ ,  $PSF_{\text{Procedure}}$ ,  $PSF_{\text{Working Process}}$  were found to have good significant values with positive correlation that are .740, .763 and .826. This value means that the higher states of Prevalence Stress may cause higher score selection of the identified PSFs among respondents. The higher selections on PSF composites would results in higher value of Human Error Probability.

#### 4. Conclusion

The positive correlation between DASS and PSF the procedure for HEP measures showed that the higher the stress the higher would be the respondent's negative perception of the procedure. Individuals who experienced this high stress might feel that the present procedure was incomplete as compared to those with low stress that gave positive perceptions when the respondent assumed that the procedure was normal and oriented. A person with high stress may experience cognitive impairment. When the cognitive function was disrupted, the respondent could not properly evaluate the existing procedure. When we did not understand something, this would cause the occurrence of stress. One of the probable causes of experiencing high stress was many emergency procedures that were not well understood by the respondents. This situation is very parallel with one's service period. For new operators in the service, this is one of the main reasons they are not very fluent about certain procedure, especially the rarely implemented procedures. Therefore it is important to propose adequate training activity with related with abnormal situation to the RTP operators.

#### 5. References

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