

ABSTRACT

There are many formal techniques for the systematic analysis of occupational safety and health in general as well as specific areas. Currently there is increased interest in the evaluation of environmental safety and health. In the light of this a project was initiated for the evaluation of environmental safety and health at the Sultan Yusuf Hydro Electric Power generation Plant (JOR Power Station) at Cameron Highlands in Pahang. It was with a view to creating a conceptual framework for hazard identification and risk assessment at the power generating station of the plant and to recommend control measures with respect to environmental safety and health for the people, particularly the employees and workers, the process and the environment.

In this study hazard identification was used to identify the primary and secondary or specific hazards which may be inherent in the system and determined as serious threat for plant operation and maintenance. The following methods were used to identify hazards at the JOR hydroelectric Power Station: checklists, work place inspection which included observation and interview, task safety analysis or job hazard analysis as well as accident and incident investigation.

For risk assessment, the Likert scale was complemented by the Severity matrix analysis in order to determine the probability and extent of the situation at the Power generation plant. Together with the hazards identified, risk assessment was used to identify control measures in order to mitigate, as well as, eliminate hazards in the system by applying some controlling method such as, personal protective equipment, administrative and engineering control which would subsequently be monitored in order to establish a safety system for the plant. Meanwhile, wastes-related risks are also identified and mitigated in purpose study plant.

A total of forty-one important hazard items were identified at the JOR power station system. These hazards were mainly identified by means of checklists which were sourced from literature and subsequently customized for the current purpose. Risk assessment was conducted by initially classifying the hazards into three levels such as Low, Medium and High. Generally 66% of the hazards identified were at low risk, 32% at medium and 2% at high risk. This indicated that there was sufficient awareness and commitment to safety and health at the Sultan Yusuf Hydro Electric Power generation Plant (JOR power station). There was a resident safety officer in place with a safety committee who together ensure the safety and health of the plant. Meanwhile the JOR Power Station was also certified by MS 1722:2005, OHSAS 18001, MS ISO 14001:2004, MS ISO 9001:2000 and scheduled waste regulation 2005 which give credibility to the current study in creating a working framework which may find widespread application in the future. This study was with a view to creating a model which may be used to identify hazards and assess risks at similar power generation plants of a hydro electric nature, as well as, to enable new hydro electric power generation plants to put a safety system in place.

ABSTRAK

Terdapat pelbagai teknik formal untuk analisis sistematik keselamatan dan kesihatan pekerjaan dari segi umum dan spesifik. Pada masa kini terdapat semakin tinggi perhatian ditumpukan kepada penilaian keselamatan dan kesihatan dalam persekitaran. Justeru, sebuah projek dijalankan untuk menilai keselamatan dan kesihatan persekitaran di loji janakuasa hidro-elektrik Sultan Yusuf (Stesen janakuasa JOR) di Cameron Highlands, Pahang. Ini berdasarkan kehendak untuk membuat rangka kerja konsep mengenal pasti bahaya dan penilaian risiko di stesen jana kuasa loji tersebut dan juga untuk memberi saranan langkah-langkah kawalan untuk keselamatan dan kesihatan persekitaran bagi orang ramai, khususnya staf dan pekerja, dan proses serta persekitaran.

Untuk mengenal pasti bahaya senarai semak yang relevan selalu digunakan untuk mengenal pasti bahaya utama dan sekunder yang spesifik yang sedia ada dalam sistem. Ini mengambil kira *hazards* yang mungkin di tentukan sebagai menjana ancaman serius terhadap pekerja, fasiliti dan alam sekitar. Kaedah berikut digunakan untuk mengenal pasti bahaya di stesen jana kuasa hidro-elektrik JOR: senarai semak, pemeriksaan tempat kerja yang merangkumi pemerhatian dan temu bual, analisis keselamatan tugas atau analisis bahaya kerja serta penyiasatan kemalangan dan insiden.

Untuk menilai risiko, skala Likert dikomplemen oleh analisis matriks keterukan (*Severity matrix analysis*) untuk menentukan probabiliti dan takat situasi di stesen janakuasa tersebut. Bersama bahaya yang dikenal pasti, penilaian risiko juga akan digunakan untuk mengenal pasti langkah-langkah kawalan supaya gerakan mitigasi dan nyah hazard dalam sistem boleh dipantau seterusnya sebagai usaha membina sistem

keselamatan untuk loji itu. Model tersebut akan diuji pematuhan serta prestasinya seperti dinyatakan dalam objektif reka bentuk implementasi keselamatan dalam loji itu.

Sebanyak 41 *hazard items* penting dikenal pasti dalam sistem di stesen janakuasa JOR. Hazard-hazard ini kebanyakannya dikenal pasti melalui senerai semak yang di dapati daripada literatur dan seterusnya diadaptasi untuk disesuaikan bagi tujuan semasa. Penilaian risiko dilakukan bermula dengan mengklasifikasikan bahaya kepada tiga tahap iaitu Rendah, Pertengahan dan Tinggi. Umumnya, 66% bahaya dikenal pasti sebagai berisiko rendah, 32% berisiko pertengahan dan 2% berisiko tinggi. Ini menunjukkan terdapat kesedaran dan komitmen secukupnya terhadap keselamatan dan kesihatan di loji janakuasa hidro-elektrik Sultan Yusuf (stesen janakuasa JOR). Terdapat pegawai keselamatan yang bermastautin di sana dan juga jawatankuasa keselamatan yang bekerjasama untuk memastikan keselamatan dan kesihatan pusat janakuasa tersebut. Dalam pada itu, stesen janakuasa JOR telah menerima pengiktirafan MS 1722:2005, OHSAS 18001, MS ISO 14001:2004, MS ISO 9001:2000 dan sisa terjadual peraturan 2005 yang memberi kredibiliti kepada kajian pengkaji dalam membangunkan model working yang besar kemungkinan dapat diaplikasi secara meluas pada masa hadapan. Tujuan kajian adalah untuk membina suatu model yang boleh digunakan untuk mengenal pasti bahaya (hazard) dan menilai risiko di loji janakuasa hidro-elektrik yang serupa dan juga membenarkan loji penjanakuasa hidro-elektrik yang baru untuk memasang sistem keselamatan mereka.

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TABLE OF CONTENTS

	Page
ABSTRACT	ii
ABSTRAK	iv
ACKNOWLEDGEMENT	vi
TABLE OF CONTENTS	vii
LIST OF FIGURES	x
LIST OF TABLES	xi
LIST OF SYMBOLS AND ABBREVIATIONS	xiii
LIST OF APPENDICES	xv
CHAPTERS	
1 INTRODUCTION	1
1.1 INTRODUCTION TO HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL	2
1.2 SCOPES OF THE STUDY	6
1.3 CAMERON HIGHLANDS HYDROELECTRIC POWER GENERATION PLANT	6
1.4 PROBLEM STATEMENT	9
1.5 OBJECTIVES	10
2 LITERATURE REVIEW	11
2.1 THE EVOLUTION OF OPERATIONAL SYSTEM OF POWER GENERATION PLANT IN HYDRO ELECTRIC DAM	11
2.1.1 Advantages and disadvantages of hydroelectricity	22
2.2 HAZARDS IDENTIFICATION IN HYDROELECTRIC DAM, POWER GENERATION PLANT	30

2.3 RISK ASSESSMENT AND CONTROL MEASUREMENT IN HYDROELECTRIC DAM, POWER GENERATION PLANT	33
2.4 HISTORY OF TESTING (HIRARC) MODEL FOR SAFETY AND HEALTH IN HYDROELECTRIC DAM, POWER GENERATION PLANT	45
2.5 EVALUATE RISKS CAUSED BY WASTES AT POWER GENERATION PLANT IN HYDROELECTRIC DAM	50
3 METHODOLOGY	56
3.1 METHODS OF HAZARD IDENTIFICATION	58
3.1.1 Hazard identification checklist	58
3.1.2 Work place inspection (observation and interview)	58
3.1.3 Task safety analysis or job hazard analysis	59
3.1.4 Accident and incident investigations	60
3.2 METHODS OF RISK ASSESSMENT	61
3.2.1 Risk matrix ranking	62
3.2.1.1 Likelihood of an occurrence	62
3.2.1.2 Severity of hazard	63
3.2.1.3 Risk assessment	64
3.3 CONTROL MEASUREMENTS METHODS	66
3.3.1 At the source of the hazard	66
3.3.2 Engineering controls	66
3.3.3 Administrative controls	67
3.3.4 Personal protective equipment (PPE)	68
4 RESULTS AND DISCUSSION	69
4.1 HAZARDS IDENTIFICATION AT SULTAN YUSUF HYDROELECTRIC POWERGENERATION PLANT (JOR POWER STATION)	69

4.1.1 Hazard identification checklist	70
4.1.2 Work place inspection (observation and interview)	90
4.1.3 Job hazard analysis and Accident investigations	108
4.2 RISK ASSESSMENT AT SULTAN YUSUF HYDROELECTRIC POWER GENERATION PLANT (JOR POWER STATION)	111
4.2.1 Risk matrix ranking	111
4.3 WASTES – RELATED RISKS AT SULTAN YUSUF HYDROELECTRIC POWER GENERATION PLANT (JOR POWER STATION)	128
4.4 EVALUATION OF RISK CONTROL ON SULTAN YUSUF HYDROELECTRIC POWER GENERATION PLANT (JOR POWER STATION)	132
4.5 GENERAL DISCUSSION	134
5 CONCLUSION AND RECOMENDATION	137
5.1 CONCLUSION	137
5.2 RECOMMENDATIONS	139
REFERENCES	141
APPENDICES	146

LIST OF FIGURES

Figure	Page
Figure 1.1: General flow of risk assessment	4
Figure 1.2: The Cameron Highlands & Batang Padang hydro electric scheme	8
Figure 2.1: The Hydroelectric power generation process	13
Figure 2.2: Three different types of turbines	16
Figure 2.3: Hydroelectric dam generator	17
Figure 2.4: Sedimentation in Hydroelectric dam	26
Figure 3.1: Framework of the methodology	57
Figure 4.1: Percentage of three risk levels in the JOR power generation plant	124
Figure 4.2: Percentage of five main classified hazards, result in JOR power plant	126
Figure 4.3: Classified three risk levels result for five main hazards in JOR hydroelectric power generation plant	127
Figure 4.4: Waste management flow chart in JOR hydroelectric power station	131

LIST OF TABLES

Table	Page
Table 1.1: Hydroelectric power stations in Malaysia	5
Table 1.2: Classification of hydroelectric power generation plant based on capacity	7
Table 2.1: Capacities of hydroelectricity generation in selected countries	20
Table 2.2: Controlling exposures to selected chemical and biological hazards in hydroelectric power generation	35
Table 2.3: The risk exposures for a hydroelectric power plant	44
Table 3.1: Likelihood values	63
Table 3.2: Indications of severity	63
Table 3.3: Risk matrix values	64
Table 3.4: Risk descriptions	65
Table 3.5: Engineering control parameters	67
Table 3.6: Administrative controls parameters	68
Table 4.1: Results of hazardous chemical exposures checklist	72
Table 4.2: Results of electrical hazard checklist	76
Table 4.3: Results of mechanical hazard checklist	80
Table 4.4: Results of ergonomic hazard checklist	83
Table 4.5: Results of biological hazard checklist	85
Table 4.6: Results of first-aid and fire-fighting equipment checklist	87
Table 4.7: Method of control checklist	89
Table 4.8: Result of worksite general inspection checklist	92

Table 4.9: Result of training inspection checklist	93
Table 4.10: Result of work processes checklist	94
Table 4.11: Result of record keeping checklist	95
Table 4.12: Result of fire emergency procedures checklist	96
Table 4.13: Result of means of exit checklist	98
Table 4.14: Result of lighting checklist	99
Table 4.15: Result of machine guards checklist	100
Table 4.16: Result of tools and machinery checklist	101
Table 4.17: Result of confine spaces checklist	102
Table 4.18: Result of housekeeping checklist	103
Table 4.19: Result of sound level/noise checklist	104
Table 4.20: Result of employee facilities checklist	106
Table 4.21: Result of (PPE) checklist	107
Table 4.22: Result of Job Hazard Analysis checklist	109
Table 4.23: Result of Accident Investigation Checklist	110
Table 4.24: Result of applied (HIRARC) in JOR hydroelectric power station	112
Table 4.25: Wastes-related hazards in the JOR power station	129

LIST OF SYMBOLS AND ABBREVIATIONS

AD control	Administrative control
CIGRE	The International Council on Large Electric Systems
CHESF	Companhia Hidro-Elétrica do São Francisco.
CH ₄	Methane
dBA	DeciBels Adjusted
DOSH	Department of Occupational Safety and Health
DOE	Department of Environment
ETH	Electronic Trading Hours
ERP	Enter price resource planning
FERC	Federal Energy Regulatory Committee,
Ft	Foot or feet
G	Gram
GW	Gig watt
GWa	Gig watt-year'
HIRARC	Hazard Identification, Risk Assessment and Risk control
ISO	International Organization for Standardization
JHA	Job Hazard Analysis
KV	Kilowatts
kWh	Kilo watt per hour
LSC	Life Safety Code

MW	Megawatts
MS	Management system
MSDS/CSDS	Material Safety Data Sheet /Chemical Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
NOX	Mono-nitrogen oxides
NFPA	The National Fire Protection Association
NSC	National Safety Council
NGO	Non-Governmental Organization
O2	Oxygen
OHSAS	Occupational health & safety standard
OR-OSHA	Oregon Occupational Safety and Health Division
OSHA	Occupational Safety and Health Administration
OSH	Occupational safety and health
PPE	Personal protective equipment
PMA	Parts Manufacturer Approval
Rpm	Rotations per minute
SMS	Safety Management System
TNB	Tenaga Nasional Berhad
TNB HQ	Tenaga Nasional Berhad Headquarter
UCPTE	Union for the Co-ordination of Production and Transmission of Electricity

LIST OF APPENDICES

APPENDICES	Page
(Appendix A): HIRARC Form	146
(Appendix B): Hazard Identification Checklist	147
(Appendix C): General Work Place Inspection Checklist	160
(Appendix D): Interview Questions	171
(Appendix E): Sample Job Hazard Analysis Form	174
(Appendix F): Accident Investigation Form	175
(Appendix G): Classified risk levels for specific hazards in JOR Power Station	177
(Appendix H): JOR Power Station	178