SPARKLE 2019

.....A glimpse of fire

IPS Academy

Institute of Engineering & Science

Fire Technology & Safety Engineering Department

O Agni! Help us to gain prosperity by leading us

On the righteous path,

You know all our thoughts and actions.

Redeem us from all our sins and evil ways.

We bow before you with gratitude.

-Rigveda

DEDICATION

A Fire and Safetyman is the member of that unselfish organization of men who hold devotion of duty above personal risk, who count sincerity of service above personal comfort and convenience, who strive, unceasingly to find better ways of protecting the homes of fellow citizens and property of the nation from the ravages of fire and other disasters. This journal is dedicated to all those who have sacrificed their lives in achieving this noble cause.

STUDENT CHAPTER

Department of Fire Technology & Safety Engineering established student chapter under Fire & Security Association of India (FSAI) in year 2016. Fire & Security Association of India (FSAI) is a non-profit organization representing the Fire Protection, Life Safety, Security, Building Automation, Loss Prevention and Risk Management domains. FSAI aims to work closely with the Government and all other stakeholders to enable the Indian fire and security industry to reach global pre-eminence with better regulatory framework. Since its establishment the department has been running engineering career oriented Quality Improvement Programme (Q.I.P.) to render the best Fire & Safety professionals to the corporate world. These programmes includes basic fire-fighting training, first aid paramedics training, design of fixed fire-fighting installations and national seminar/workshops that impart best training to our students.

Fire & Security Association of India (FSAI) MP Chapter

Student Chapter Team

PRESIDENT

SOURABH CHOUHAN

SECRETARY

HARDIK UPADHYAY

TREASURER

RAHUL DAHIYA

CR FINAL YEAR

SHASHANK

CR THIRD YEAR

ASHISH DAHIYA

CR SECOND YEAR

SHUBHAM VYAS

President's Message

I have always believed that no doubt it is important to start new projects, undertake novel ventures, but more important is to insure that they do not remain one time wonders but become a continuous process, a habit, a tradition. Therefore it gives me great pleasure to see the periodic issue "SPARKLE". I congratulate the editorial team of SPARKLE and wish them to success.

Achal K Choudhary,

President,

IPS Academy Indore (MP) India

Principal's Message

Technical Education is the most potential instrument for socio-economic change. Presently, the engineer is seen as a high-tech player in the global market. Distinct separation is visible in our education between concepts and applications. Most areas of technology now change so rapidly that there is a need for professional institutes to update the knowledge and competence.

Institute of Engineering and Science, IPS Academy is a leading, premium institution devoted to imparting quality engineering education since 1999. The sustained growth with constant academic brilliance achieved by IES is due to a greater commitment from management, dynamic leadership of the president, academically distinctive and experienced faculty, disciplined students and service oriented supporting staff.

The Institute is playing a key role in creating and ambiance for the creation of novel ideas, knowledge, and graduates who will be the leaders of tomorrow. The Institute is convinced that in order to achieve this objective, we will need to pursue a strategy that fosters creativity, supports interdisciplinary research and education. This will also provide the students with an understanding and appreciation not only of the process of knowledge creation, but also of the process by which technology and knowledge may be used to create wealth as well as achieve social economic goals.

I am delighted to note that the engineering graduates of this institute have been able to demonstrate their capable identities in different spheres of life and occupied prestigious position within the country and abroad. The excellence of any institute is a measure of achievements made by the students and faculty.

All the Best.

Dr. Archana Keerti Chowdhary

Principal

HOD's Message

In order to achieve the aims and objectives of the society we plan to undertake some useful activities like organizing seminars, workshops and conferences at national and international level and publication of relevant technical literature. In this process it has been decided to publish a technical magazine entitled "Sparkle". The magazine is covering area relating to Fire, Safety and Occupational health/ hygiene. The article and research paper being contributed by the student writers with a mission of spreading awareness about Fire Prevention and Protection, Industrial Safety and Occupational health/hygiene. This will also help in generating awareness and educating the common people, which in turn will help in reducing loss of life and property. The society will provide the National Forum to meet and discuss the various issues and developments in the field of fire protection and industrial safety. The technical magazine will have a wider circulation among leading consultants, organizations concerned with the Fire, Safety and Environment protection.

Dr. Praveen Patel
Head of Department

EDITORIAL BOARD

ADVISORY BOARD

EXECUTIVE & EDITOR IN CHIEF

Mr. Veerendra Suryawanshi -Assistant Professor

EDITORIAL TEAM

Mr. Hardik Upadhyay - Student 4th Year
Mr. Rahul Mahajan - Student 3rd Year
Mr. Shubham Vyas - Student 2nd Year

PUBLISHED BY

IPS Academy, Indore
Institute of Engineering and Science
Fire Technology and Safety Engineering Department

CONTENTS

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: To provide student with an academic environment aware of excellence, outstanding leadership, written, ethical codes and guidelines with moral values, and the life-long learning needed for a successful professional career.

PEO 2: To prepare students for job profile of Fire/Safety Officer with professional advancement in fire technology and safety engineering field through global education.

PEO 3: To provide students with basic foundation in mathematical, scientific and engineering fundamentals for solving complex problem in fire technology and safety engineering and to pursue higher studies.

PEO 4: To trained students with good scientific, engineering and life safety breadth so as to comprehend analyze, design and create novel products and solutions for the real life problem.

PEO 5: To inculcate in students professional and ethical attitude, effective communication skills, team work skills, multidisciplinary approach and ability to relate fire and safety engineering issues to broader and social context.

PROGRAM OUTCOMES (POs)

The POs as recommended in National Board of Accreditation (NBA), New Delhi manual are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Ability to design solution for the complex major hazardous industries in terms of fixed fire-fighting installations and fire prevention that meet the specified needs.

2. Ability to describe the impact of safety engineering solutions in environmental, economic and societal context.

Department Information

Department of Fire Technology & Safety Engineering was established in the year 1999. The Department became the first AICTE Approved Engineering Department for providing four years Bachelor degree of Engineering in Fire Technology & Safety Engineering.

Since its establishment the department has been running engineering career oriented Quality Improvement Programme (Q.I.P.) to render the best Fire & Safety professionals to the corporate world. These programmes include basic fire-fighting training, first aid paramedics training, design of fixed fire-fighting installations and national seminar/workshops that impart best training to employee of Industries to gain skills.

Department of Fire Technology & Safety Engineering is a leading department devoted to imparting quality Fire & Safety Engineering education. Apart from AICTE New Delhi, approval and affiliation with the Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, department has also got approval from the Chief Factory Inspectorate Labor Department, Govt. of M.P. as per Gazette notification dated 29.05.2009.

COURSES OFFERED:-

1. UG – B.E. in Fire Technology & Safety Engineering
2. UG – B.E. in Safety and Fire Engineering
3. PG – M.Tech. in Industrial Safety Engineering

VISION & MISSION OF THE DEPARTMENT

Vision

To generate, develop and sustain a voluntary movement on Fire & Safety Engineering at the National Level aimed at educating and influencing society to adopt appropriate policies, practices and procedures that prevent and mitigate human suffering and economic loss arising from all types of accidents.

Mission

1 To create and sustain a community of learning in which students acquire knowledge in fire, safety and hazard management and learn to apply it professionally with due consideration for ethical, human life & property safety issues.

2 To pursue research and development in fire safety engineering, hazard management and disseminate its findings.

3 To meet the challenges of today and tomorrow in the most effective, efficient and contemporary educational manner.

4 To help in building national capabilities in fire safety engineering, disaster management, hazard management, industrial safety education through practical training to ensure a fire safe nation.

DEPARTMENT FACULTY DETAILS

S. No.	Name of Faculty	Highest Qualification	Designation	Date of Joining
1	DR. PRAVEEN PATEL	Ph.D	Professor	02.08.2004
2	DR. R J LALWANI	Ph.D	Professor	22.08.2016
3	DR. S.N. VARMA	Ph.D	Professor	04.01.2016
4	DR.ADITYA TIWARY	PhD	Associate Professor	08.08.2019
5	DR. JAIVEER SINGH	P.hD	Assistant Professor	01.05.2010
6	MR. PRAVEEN BADODIA	M.Tech	Assistant Professor	04.03.2011
7	MR. VINEET BANODHA	M.Tech	Assistant Professor	17.08.2010
8	MR. VEERENDRA SURYAWANSHI	M.Tech	Assistant Professor	01.01.2013
9	MR. YASHWANT BUKE	M.Tech	Assistant Professor	08.10.2010
10	MR. AASHISH YADAV	M.Tech	Assistant Professor	12.01.2012
11	MR. VIJAY KR. SHANKUL	M.Tech	Assistant Professor	13.03.2013
12	MS. SHALINI BHARDWAJ	M.Tech	Assistant Professor	08.08.2012
13	MR. VIJAY KAHAR	M.Tech	Assistant Professor	01.08.2013
14	MR. SOURABH JAIN	ME	Assistant Professor	08.08.2012
15	MR.GOURAV ANTHONY	M.Tech	Assistant Professor	01.08.2018
16	MR. B.N. PHADKE	M.Tech	Assistant Professor	27.03.2010
17	MR. MANISH DUBEY	M.Tech	Assistant Professor	14.06.2014
18	MR N K JAIN	B.Tech	Assistant Professor	09.02.2009
19	MR HEMENDRA PATIL	M.Tech	Assistant Professor	22.08.2018
20	MR. RAMJEE SINGH PRAJAPATI	M.Tech	Assistant Professor	22.08.2018
21	MR KAMAL SHUKLA	M.Tech	Assistant Professor	08.08.2019
22	MR PRAVEEN TATODE	M.Tech	Assistant Professor	08.08.2019
23	MR. R M CHOUKSE	BE, LLB.HONS.	Assistant Professor	20.08.2006

Department Achievements

S. No.	Details	No.
1	Faculty Development Programs Organized	02
2	Seminar Organized	01
3	Workshop Organized	03
4	Expert Lectures Organized	12
5	Industrial Visit Organized	03
6	Training Organized	01
7	Other Events Organized	02

Faculty Achievements

S.No.	Topic	No.
1	Special Awards	11
2	Paper Published in Journals	05
3	Paper Presented in Seminar/Conference	04
4	Lectures Delivered By Faculties in Seminars And Workshop	10
5	Seminar & Workshop Attended	04
6	SDP/FDP Attended	09

Students Achievements

S.No.	Topic	No.
1	Special Awards	06
2	Received Vice Chancellor's Scholarship	04
3	Academic Awards	18
4	Paper Published in Journals	01
5	Paper Presented in Seminar	22

Participation in inter-institute events by students of the program of study

S.No.	DATE		Name of the Event	Awardees Name	Prize/ Certificate	Organized by
	From	To				
1	24/10/2018	24/10/2018	Panel Discussion in One Week National Tech Fest on "Advances in Fire Technology & Safety Engineering"	Rajat Gupta Shubham Agrawal Tanish Kapoor Ritesh Asawara Yaman Yadav Nikhil Gautam	Secured 1st Prize	Department of FT & SE IPSA
2	24/10/2018	24/10/2018	Panel Discussion in One Week National Tech Fest on "Advances in Fire Technology & Safety Engineering"	Priyansh Upadhyay Akash.K.Raj Shiristi Kotiyal Nikhil Dubey Asac Thomas Shashank	Secured 2nd Prize	Department of FT & SE IPSA
3	25/10/2018	25/10/2018	Innovative Ideas/Proto Type Model Competition in One Week National Tech Fest on "Advances in Fire Technology & Safety Engineering"	Naman Pandit Nikhil Dubey Nikhil Sharan Nilesh Patidar Nishita Chouhan	Secured 1st Prize	Department of FT & SE IPSA
4	25/10/2018	25/10/2018	Innovative Ideas/Proto Type Model Competition in One Week National Tech Fest on "Advances in Fire Technology & Safety Engineering	Anil Kumar Patidar Aniruddha NAmdev Ankit Ankit Mourya Anmol Kumar Anoop Manhor	Secured 2nd Prize	Department of FT & SE IPSA

S.No.	DATE		Name of the Event	Awardees Name	Prize/ Certificate	Organized by
	From	To				
5	26/10/2018	26/10/2018	Quiz Competition in One Week National Tech Fest on "Advances in Fire Technology & Safety Engineering	Kuldeep Singh Rajput Hemant Ojha	Secured 1st Prize	Department of FT & SE IPSA
6	26/10/2018	26/10/2018	Quiz Competition in One Week National Tech Fest on "Advances in Fire Technology & Safety Engineering g	Tarun Gupta Paras Singh Rajput	Secured 2nd Prize	Department of FT & SE IPSA
7	05/04/2019	05/04/2019	Research Paper Competition in VINDICATOR 2019	Palash Gavte	Secured 1st Prize	Department of FT & SE IPSA
8	05/04/2019	05/04/2019	Poster Paper Competition in VINDICATOR 2019	Akash K. Raj Arpita Roy Avdhaveer Singh Rajawat Bhawesh Bajaj Gaurav Bhawsar Mohd Mohatshim Preeti Gangele	Secured 1st Prize	Department of FT & SE IPSA
9	06/04/2019	06/04/2019	Trailer Pump Drill Competition in VINDICATOR 2019	Sarthak Phanse Tushar Gaur Rajat Verma Sagar Soni Yash Kamlesh Vinayak Choudhary	Secured 1st Prize	Department of FT & SE IPSA
10	06/04/2019	06/04/2019	Rolling & Unrolling of Hose Competition in VINDICATOR 2019	Aakash.K. Raj	Secured 1st Prize	Department of FT & SE IPSA

S.No.	DATE		Name of the Event	Awardees Name	Prize/ Certificate	Organized by
	From	To				
11	06/04/2019	06/04/2019	BA Set Drill Competition in VINDICATOR 2019	Karunesh Kashyap Mohit Kumar	Secured 1st Prize	Department of FT & SE IPSA
12	06/04/2019	06/04/2019	Casualty Carry Competition in VINDICATOR 2019	Arpit Verma Akash Namdev Ambaliya Manish Md Tabish	Secured 1st Prize	Department of FT & SE IPSA
13	06/04/2019	06/04/2019	Fire Extinguishers Drill Competition in VINDICATOR 2019	Vaibhav Sharma Geeta Soni Fahim Ansari	Secured 1st Prize	Department of FT & SE IPSA
14	06/04/2019	06/04/2019	Knots & Hitches Competition in VINDICATOR 2019	Pradeep Singh Yadav	Secured 1st Prize	Department of FT & SE IPSA
15	06/04/2019	06/04/2019	Fire Tender Drill	Naman Pandit Rahul Jat Ritesh Asavara Ravi Singh Rajat Gupta Sagar Gami	Secured 1st Prize	Department of FT & SE IPSA
16	06/04/2019	06/04/2019	Rope Climbing	Shahnawaz Sheikh	Secured 1st Prize	Department of FT & SE IPSA
17	06/04/2019	06/04/2019	Rope Rescue	Aadrsh Sendhav	Secured 1st Prize	Department of FT & SE IPSA
18	06/04/2019	06/04/2019	Squad Drill	Rahul Mahajan Ravi Singh Ritesh Asavara Radheshyam Kamde Rajat Gupta Shivani Shah & Team	Secured 1st Prize	Department of FT & SE IPSA

Research Papers Presented/Publication

Paper Presented in Seminar/ Conference National

S No.	Name of Students	Title of Paper	Detail of Seminar/ Conference Proceeding and organized by
1	1. Aditya Gangar 2. Ashish Pal 3. Chaitanya Bhole 4. Hardik Upadhyay 5. Mayank Jhanjhari 6. Mayank Yadav	Disaster Management Plan for Flood disaster	Research Paper Competition in VINDICATOR 2019
2	1. Deepak Kushwah 2. Dharmendra Patel 3. Monu Lodhi 4. Md. Rashid Nawab 5. Muaz Ahmed 6. Krishna Kumar Gupta	Safety Review of a Manufacturing unit with advice on control measure	Research Paper Competition in VINDICATOR 2019
3	1. Aachman Sharma 2. Aman Tanwar 3. Asad Shan 4. Harish Patidar 5. Harshit Jain 6. Matte Pravin Mahadev 7. Mohd. Laareb Khan	Risk assessment of Horizontal Pressurized Chlorine tonner in Thermal Power Plant.	Research Paper Competition in VINDICATOR 2019
4	1. Akash K. Raj 2. Arpita Roy 3. Avdhaveer Singh Rajawat 4. Bhawesh Bajaj 5. Gaurav Bhawsar 6. Mohd Mohatshim 7. Preeti Gangele	Assessment of fire safety and Evacuation management in hospital.	Research Paper Competition in VINDICATOR 2019
5	1. Abhilash Ashapure 2. Balram Patel 3. Giriraj Vyas 4. Lokesh Carpenter 5. Manish Patil 6. Manoj Carpenter	Improvement in the working efficiency of worker by using Micro & Memo technique	Research Paper Competition in VINDICATOR 2019
6	1. Abdul Rehan 2. Abdul Rehman 3. Aditya Sharma 4. Ajay Singh Rajput 5. Aradhya Gupta 6. Md Sahil Malek	Modeling of destruction pattern of explosion in a Fire Cracker Shop	Research Paper Competition in VINDICATOR 2019

S No.	Name of Students	Title of Paper	Detail of Seminar/ Conference Proceeding and organized by
7	1. Arpit Verma 2. Devashish Khairwa 3. Manoj Bhilala 4. Mayank Shrivastava 5. Nikhil Bagdi 6. Nitin Thorecha	Developing Safety indicators for preventing heat stress	Research Paper Competition in VINDICATOR 2019
8	1 .Abhishek 2. Amey Sarathe 3. Arun Rathore 4. Deepak Kumar Sad 5. Dharmendra Nagar 6. Kapil Patidar	Evaluation of water supply requirements for residential fire sprinkler system	Research Paper Competition in VINDICATOR 2019
9	1. Aditya Patidar 2. Mayank Choudhary 3. Amit Patidar 4. Mohit Gupta 5. Krishna Choudhary 6. Bhupendra Patel 7. Lakhan Chandore	Fire Extinguishing performance testing of gas and DCP media over mixed media of DCP & Gas	Research Paper Competition in VINDICATOR 2019
10	1. Hariom Sharma 2. Kartikey Singh Baghel 3.Ashutosh Soni 4. Abnave Abhilash 5.Chetan Kadoliya	Occupational health & Safety of foundry workers	Research Paper Competition in VINDICATOR 2019
11	1. Rahul Kumar 2. Abhay Raj 3. Abhishek Gupta 4. Arpit Agrawal 5. Ayush Gupta 6. Kuldeep Singh Rajput 7. Ashutosh Soni	Design of water spray system for flammable liquid tank in Oil & Gas Industry	Research Paper Competition in VINDICATOR 2019
12	1. Rohit Aanjana 2. Saddam Mansuri 3. Soubhik Banerjee 4. Shivam Nagori 5. Spersh Patankar 6. Soheb Mansoori	Fire Water Design and Demand for the water storage in Refinery Division	Research Paper Competition in VINDICATOR 2019
13	1. Pankaj Shukla 2. Rehmat Ali 3. Shashank Khatri 4. Shivam Khandelwal 5.Shubham Khatri 6. Virendra Singh	Design fires with mixed material burning cribs to determine the extinguishing effects of compressed air foams	Research Paper Competition in VINDICATOR 2019

S No.	Name of Students	Title of Paper	Detail of Seminar/ Conference Proceeding and organized by
14	1. Piyush Raj 2. Priyansh Khandelwal 3. Rahul Singh 4. Rajneesh Kumar 5. Shubham Dixit 6. Ujjawal Kumar 7. Vivek Krishan Satyam	Rim Seal Protection system for storage tank in Refinery division	Research Paper Competition in VINDICATOR 2019
15	1. Prashant Saini 2. Sandeep Singh 3. Sujith Kumar 4. Tarun Gupta 5. Aman Singh Tomar 6. Ravi Nayak Patel	Total Safety Management (TSM) Implementation in Manufacturing Industry	Research Paper Competition in VINDICATOR 2019
16	1. Raghav Malik 2. Mohit Solanki 3. Prakhar More 4. Priyansh Upadhyay 5. Rishabh Rathore 6. Sourabh Chouhan	Assessment of the fire suppression system in high rise building	Research Paper Competition in VINDICATOR 2019
17	1. Pranav Dubey 2. Shubham Engle 3. Shubham Pimple 4. Siddhant Dani 5. Tanmay Saxena 6. Uma Mehra	Design a evacuation plan for the multistory building and prepare a emergency layout for the same	Research Paper Competition in VINDICATOR 2019
18	1. Rahul Patidar 2. Rajesh Lodha 3. Sandeep Chouhan 4. Shubham Chouhan 5. Harsh Digarse 6. Shashank Jain	Design of water mist system for prevention at bulk storage of liquid flammable material	Research Paper Competition in VINDICATOR 2019
19	1. Palkesh Gupta 2. Pankaj Keshre 3. Sahil Rana 4. Tushar Choudhary	Assessment of ammonia gas occupational hazard using data analysis in cold storage	Research Paper Competition in VINDICATOR 2019
20	1. Rajesh Kumar 2. Ronit Gehlot 3. Vivek Kanade 4. Parixit Rao 5. Pritam Kumar 6. Priyam Songara	Wireless Sensor for Forest Fire Early Detection & Online Remote Monitoring using Fire Sensor	Research Paper Competition in VINDICATOR 2019

S No.	Name of Students	Title of Paper	Detail of Seminar/ Conference Proceeding and organized by
21	1. Sumit Patel 2. Tabib Khan 3. Sandarbh Sharma 4. Vikas Dagdi 5. Vishal Gupta 6. Pradeep Kumar	Electrical fire risk assessment in Chemical process plant.	Research Paper Competition in VINDICATOR 2019
22	Palash Gawte	Industrial Threat Protection System	Research Paper Competition in VINDICATOR 2019

VINDICATOR-2019

The department of Fire Technology & Safety Engineering IPS- IES Academy organized "VINDICATOR-2019"on 5th April 2019 to 6th April 2019. Day one was planned for "Project Competition via Technical Paper Writing & its Presentation" having objective to groom and record quality project work among UG & PG students. Day second was planned for Cogent Fire fighting outdoor competition having objective to perform and practice the available standard emergency drill with required/expected coordination and time limit in fire service. The details on activities performed during both days are as follows:

Day1 (05/04/2019)

TITLE: "Project Competition via Technical Paper Writing & its Presentation"

OBJECTIVE: The objective of this academic event to groom and record quality project work among UG & PG students of Fire Technology & Safety Engineering domain. This activity also intends to publish research, review, and short article in this field.

FOCUSED TOPICS:

- Fire Protection Systems
- Occupational Health & Industrial Hygiene
- Safety Engineering & Ergonomics
- Nuclear Engineering & Safety
- Integrated Control & Factory Act with other Important Acts Concerned with Safety Domain
- Risk Assessment & Analysis
- Fire Dynamics and Explosion Control
- Environment and Ecology Protection
- Hazardous Material Storage & Transportation.

PAPER WRITING GUIDELINES: A team of maximum four members were participated in the competition and following heads were mentioned in paper and its presentation.

1. Title Introduction

2. Literature Review
3. Problem Formulation
4. Area of Study
5. Material and Methodology
6. Result & its Interpretation
7. Conclusion, Recommendation and Future Scope
8. References

REGISTRATION: There were total 10 groups compete with each other in Paper Presentation the details on the same are as follows:

Sr. No.	Name of the Students	Paper/Project Title
01	Aachman Sharma Aman Tanwar	Risk assessment of Horizontal Pressurized Chlorine tonner in Thermal Power Plant
02	Abhilash Ashapure Balram Patel	Improvement in the working efficiency of worker by using Micro & Memo technique
03	Rahul Kumar Abhay Raj Abhishek Gupta	Design of water spray system for flammable liquid tank in Oil & Gas Industry
04	Abhishek Amey Sarathe Arun Rathore Dharmendra Nagar	Evaluation of water supply requirements for residential fire sprinkler system
05	Hardik Upadhyay Mayank Jhanjhari	Disaster Management Plan for Flood disaster
06	Rajesh Kumar Ronit Gehlot Vivek Kanade Parixit Rao Niwadunge	Forest Fire Early Detection & Online Remote Monitoring using Fire Sensor
07	Piyush Raj	Rim Seal Protection system for storage tank in Refinery

	Priyansh Khandelwal	division
08	Pankaj Shukla Rehmat Ali	Special System for Explosion Damage Control
09	Palash Gawte	Industrial Threat Protection System
10	Neeraj Bhalerao	Cement Industry in Satna Cost, Efficiency and Environment Impact

There were total 10 groups compete with each other in Poster Presentation the details on the same are as follows:

Sr. No.	Name of the Students	Poster Title
01	Sumit Patel Tabib Khan	Electrical Fire Risk Assessment In Chemical Process Plant
02	Abdul Rehan Abdul Rehman Sheikh	Modelling Of Destruction Pattern Of Explosion In A Fire Cracker Shop
03	Arpit Verma Devashish Khairwa	Developing Safety Indicators For Preventing Heat Stress
04	Akash K. Raj Arpita Roy	Assessment and Survey Research on Evacuation Plan of Hospitals and Nursing Homes
05	Deepak Kushwah Dharmendra Patel	Safety Review of a Manufacturing unit with advice on control measure
06	Rohit Aanjana Saddam Mansuri	Hazard Identification in Petrochemical Industry and Precaution against Hazardous chemical
07	Pradhuman Soni	Most effective way to build intrinsic motivation for increasing performance of a worker in a petrochemical industry
08	Aditya Patidar Mayank Choudhary	Fire Extinguishing Performance Testing Of Gas And DCP Media Over Mixed Media Of DCP & Gas
09	Sandeep Chouhan Shubham Chouhan	Design Of Water Mist System For Prevention At Bulk Storage Of Liquid Flammable Material
10	Sahil Rana Tushar Choudhary ushar Choudhary	Assessment of ammonia gas occupational hazard using data analysis in cold storage

PRIZES & CERTIFICATION: One best papers and one best poster among submitted one were awarded with cash prize of Rs. 3000/- and Rs. 1800/- respectively with certificate from the Institute. Details on the same are as follows:

Sr. No.	Name of Competition	Winner's Name	Cash Prize	Certificate
01	Research Paper Presentation	Palash Gawte	3000/- (Winner)	Yes
02	Poster Presentation	Akash K. Raj	1800/- (Winner)	Yes
		Arpita Roy		Yes

Photographs day 01 (05.04.2019)

Day 2 (06/04/2019)

TITLE: "Cogent Fire-fighting outdoor competition"

OBJECTIVE: The objective of this competition is to perform and practice the available standard emergency drill with required/expected coordination and time limit in fire service. The following exercise/Fire Fighting drills were organized with below mentioned guidelines:

FOCUSED EXERCISE:

- Knots and hitches
- BA set drill
- Fire extinguisher drill
- Casualty carrying method
- Fire tender drill
- Trailer pumps drill
- Rolling and unrolling hose
- Hydrant drill
- Rope Climbing
- Rope Rescue
- Squad Drill

GUIDELINES: The number of participants and things required for individual competition are as follow:-

S.No	Exercise name	No. of participants in a group	Cash Prize	Things required	Time req. for particular exercise
1	Trailer Pump Drill	06	3000.00	1 Trailer 2 Branches 2 delivery hose	05 minutes
2	Rolling & Unrolling of Hose	01	1000.00	2 delivery hose	05 minutes
3	BA Set Drill	02	1000.00	BA set	01 minutes
4	Casualty Carry	04	2000.00	Casualty or dummy	05 minutes
5	Fire Extinguishers Drill	03	1500.00	Required particular extinguishers	05 minutes
6	Knots & Hitches	01	500.00	Ropes	05 minutes
7	Fire Tender Drill	06	3000.00	Fire Tender	05 minutes
8	Rope Climbing	01	500.00	Rope	30 Seconds
9	Rope Rescue	01	500.00	Rope	30 Seconds
10	Squad Drill	22	2200.00	Drill Ground	05 minutes

A circular for all students was circulated among students mentioning that-

✓ Students are advice to follow the standard practice for individual competition under the guidance of event coordinator.
✓ Participants should follow all the instructions of mentors.
✓ Dangri is mandatory for participants only.

PRIZES & CERTIFICATE: The awards in each competition were awarded as winner with the certificate. The details on the same are as follows:

Sr. No.	Name of Competition	Winner's Name	Cash Prize	Certificate
01	Trailer Pump Drill	Sarthak Phanse	3000/-(Winner)	Yes
		Tushar Gaur		Yes
		Rajat Verma		Yes
		Sagar Soni		Yes
		Yash Kamlesh		Yes
		Vinayak Choudhary		Yes
02	Rolling & Unrolling of Hose	Aakash.K. Raj	1000/-(Winner)	Yes
03	BA Set Drill	Karunesh Kashyap	1000/-(Winner)	Yes
		Mohit Kumar		Yes
04	Casualty Carry	Arpit Verma	2000/-(Winner)	Yes
		Akash Namdev		Yes
		Ambaliya Manish		Yes
		Md Tabish		Yes
05	Fire Extinguishers Drill	Vaibhav Sharma	1500/-(Winner)	Yes
		Geeta Soni		Yes
		Fahim Ansari		Yes
06	Knots & Hitches	Pradeep Singh Yadav	500/-(Winner)	Yes

Sr. No.	Name of Competition	Winner's Name	Cash Prize	Certificate
07	Fire Tender Drill	Naman Pandit	3000/- (Winner)	Yes
		Rahul Jat		Yes
		Ritesh Asavara		Yes
		Ravi Singh		Yes
		Rajat Gupta		Yes
		Sagar Gami		Yes
08	Rope Climbing	Shahnawaz Sheikh	500/- (Winner)	Yes
09	Rope Rescue	Aadrsh Sendhav	500/- (Winner)	Yes
10	Squad Drill	Rahul Mahajan	2200/-(Winner)	Yes
		Ravi Singh		Yes
		Ritesh Asavara		Yes
		Radheshyam Kamde		Yes
		Rajat Gupta		Yes
		Rahul Jat		Yes
		Shivani Shah		Yes
		Shikha Raghuwanshi		Yes
		Shrishti Kotiyal		Yes
		Sumit Kumar Soni		Yes
		Sagar Gami		Yes
		Sunil S. Chouhan		Yes
		Nishita Chouhan		Yes
		Naman Pandit		Yes
		Nikhil Dubey		Yes
		Mitan Vyas		Yes
		Mayank Yadav		Yes
		Abhishek Shukla		Yes
		Ankit Mourya		Yes
		Arun		Yes
		Pradhyuman Sharma		Yes
		Gandharva Pable		Yes

Photographs day 02(06.04.2019)

Entrepreneurship Awareness Camp (EAC)

The department of Fire Technology & Safety Engineering IPS- IES Academy organized "Entrepreneurship Awareness Camp" sponsored by EDI Ahmedabad from 01/11/2018 to 03/11/2018.

Programme Schedule

Date and Day	Session	Timing	Subject/Topic	Faculty
01/11/2018 1st Day	I	10:00AM to 11:30AM	Idea generation and opportunities for Entrepreneurs	Mr. Sathyam Joshi, Ms. Shree Office of Life Coach Satyam Josh , Indore (M.P.)
	II	11:30AM to 01:00PM	Government Schemes and Available Financial Assistance on Entrepreneurship in Present Scenario	Mr. Nilesh Trivedi, MSME Development Institute, Indore (M.P.)
02/11/2018 2nd Day	I	10:00AM to 11:30AM	Positioning as an Entrepreneur – Starting Your own Business	Mr. Jitendra Rajaram Verma, E cafe Venture
	II	11:30AM to 01:00PM	How to become a Successful Entrepreneur –Own Success Story	Ms. Pooja Tallera, Infinit Energy Solutions Pvt. Ltd., Indore (M.P.)
	III	01:30PM to 03:00PM	Business Creation & Venture Capitals for Entrepreneur	Mr. Vaibhav Jain, Indore (M.P.)
03/11/2018 3rd Day	Industrial Visit			

Photographs of Programme

Pic. 01 : Mr. Sathyam Joshi addressing to students about "Idea generation and opportunities for Entrepreneurs" on dated Nov. 01, 2018 Session-I

Pic. 02 : Mr. Nilesh Trivedi addressing to students about "Government Schemes and Available Financial Assistance on Entrepreneurship in Present Scenario" on dated Nov. 01, 2018 Session-II

Pic. 03 : Mr. Jitendra Rajaram Verma addressing to students about "Positioning as an Entrepreneur – Starting Your own Business" on dated Nov. 02, 2018 Session-I

Pic. 04 : Ms. Pooja Tallera addressing to students about "How to become a Successful Entrepreneur – Own Success Story" on dated Nov. 02, 2018 Session-II

Pic.05: Industrial Visit at Rama Phosphat ltd. Sanwer road , Indore, on Nov. 03, 2018

Pic.06: Industrial Visit at Mahima Purespun Pvt. ltd. sector 2, pithampur, on Nov. 03, 2018

Pic.07: Industrial Visit at Mahima Purespun Pvt. ltd. sector 2, Pithampur, on Nov. 03, 2018

One Week National Tech-Fest

On

"Advances in Fire Technology & Safety Engineering"

23rd Oct. to 27th Oct., 2018

In Association with

FIRE SECURITY ASSOCIATION OF INDIA

(FSAI)

(Non-Profit Organization Representing Fire Protection in India)

Organized by

IPS Academy, Indore (M.P.)

Institute of Engineering & Science

Department of Fire Technology & Safety Engineering

ABOUT THE TECHFEST:

Several types of manufacturing, storage and control processes are used in industry. In the context of large quantities of the potentially hazardous materials and processes handled on routine basis, effective measures are required to be developed to ensure adequate controls and safeguards to prevent accidents having serious consequences upon workers, community and property. It is therefore, a high priority that hazards are properly identified and assessed for their potential to cause serious consequences.

Occupiers of factories are statutorily required to ensure safety and health of workers and protection of the environment. The Factories Act.1948, the Environment (Protection) Act.1986 and Rules framed under these Acts have elaborate statutory provisions on safety, health and environment. The occupiers have an obligation to comply with these provisions. This seminar help in standard, organizations should establish and maintain procedures to identify hazards and assessment & control risks related to their activities.

The Department of Fire Technology & Safety Engineering, IES-IPSA, Indore is organizing a five days tech-fest on "advances in Fire Technology & Safety Engineering". This tech-fest will provide a unite platform to enhance the technical skill and knowledge of individual.

The tech-fest will be followed by Technical Session, Panel Discussion, Innovative Ideas/Projects Competition and Quiz Competition.

PARTICIPANTS:

The tech-fest is organized for academicians, researchers, fire & safety professionals, students and persons working in the related area.

Pic: Hon. HOD at Techfest

Pic: Hon. Director General of NSC at Techfest

REGISTRATION PROCESS:

Registration can be done by sending scan copy of enclosed registration form (or Xerox copy), dully filled in, at

hod.firetech@ipsacademy.org
vbanodha@gmail.com

REGISTRATION FEE:

Student from IES-IPSA	: Rs. 50/- per participant
Student from other Institute	: Rs. 200/- per participant
Faculty members (other institute)	: Rs. 500/-per Participant
Industry Participants	: Rs.1000/-per Participant.

- The fees will cover expenses for providing winner First & Second Position organize during Five Days Seminar
- Fees once paid will not be refunded.

CASH PRIZE:

Name of Competition	Prize Amount
Panel Discussion- I	Rs 5000.00
Panel Discussion- II	Rs 3000.00
Innovative Ideas/Proto Type Models-I	Rs 3500.00
Innovative Ideas/Proto Type Models -II	Rs 2000.00
Quiz Competition-I	Rs 3500.00
Quiz Competition-II	Rs 2000.00

Panel Discussion Result:

S.No.	Name of the Students	Topic	Panel In charge	Remark
1.	Rajat Gupta Shubham Agrawal Tanish Kapoor Ritesh Asawara Yaman Yadav Nikhil Gautam	Merits and demerits of social media application.	Mr.Vijay Shankul	Winner (Rs 5000 Cash Prize)
2.	Priyansh Upadhyay Akash.K.Raj Shiristi Kotiyal Nikhil Dubey Asac Thomas Shashank	Crime against women and transshipment legal punishment in Indian scenario.	Mr. Gaurav Anthony	Runner-Up (Rs 3000 Cash Prize)

Innovative Ideas/Proto Type Model Competition Result

S.No.	Presented By	Title	Remark
1.	Naman Pandit Nikhil Dubey Nikhil Sharan Nilesh Patidar Nishita Chouhan	Snakebot Hyper Redundant Robot	Winner (Rs 3500 Cash Prize)
2.	Anil Kumar Patidar Aniruddha NAmdev Ankit Ankit Mourya Anmol Kumar Anoop Manhor	Integrated Broken Rail Detection & Signaling System	Runner-Up (Rs 2000 Cash Prize)

Quiz Competition Result

S.No.	Name of the Students	Activity	Remark
1.	Kuldeep Singh Rajput Hemant Ojha	Quiz Competition	Winner (Rs 3500 Cash Prize)
2.	Tarun Gupta Paras Singh Rajput	Quiz Competition	Runner-Up (Rs 2000 Cash Prize)

Glimpses of the Techfest

Research Papers

"Modeling Of Destruction Patterns Of Explosion In Fire Cracker Shop"

1.Abdul Rehan 2.Aradhya Gupta 3.Aditya Sharma 4.Abdul Rehman 5.Md Sahil Malek
6. Ajay Singh Rajput

B.E.(Fire Technology and Safety Engineering) scholar
IPS Academy, Institute of Engineering and Science
Department of Fire Technology and Safety Engineering

Prof. Aashish Yadav
Assistant Professor
IPS Academy, Institute of Engineering and Science
Department of Fire Technology and Safety engineering

1. INTRODUCTION

A small, usually paper or cardboard container filled with an explosive that makes a loud noise. Fireworks are a class of low explosive pyrotechnic devices used for aesthetic and entertainment purpose. The most common use of a firework is as part of a fireworks display also called a firework show or pyrotechnics, a display of the effects produced by the firework devices. A violent shattering apart of something as is caused by a explosive., whether solid or liquid or gaseous used or manufactured with a view to produce a practical effect by explosion or pyrotechnic effect; and includes fog-signals, fireworks, fuses, rockets, percussion caps, detonators, cartridges. Explosion effects generally include those of overpressure, thermal effects, energized projectiles (fragments, debris, and missiles), ground shock, and cratering. Although for larger explosions, ground shock can result in damage to underground structures and utilities.

2. LITERATURE REVIEW

Total 8 different fire cracker explosion model research papers for different scenario has been reviewed by us during dissertation. Modeling of destruction pattern of explosion in a firecracker shop so as to limit the damage which may be caused after a fire cracker explosion. Using the survey of different data from different types of shops modeling of firecracker explosion is done.

3.PROBLEM DOMAIN

The fire cracker shops at busy market areas not only create traffic problems but also are a threat if there is an accident. The police should also ensure that these shops have adequate fire prevention and fire fighting measures in place.

Observing the absence of such a crucial legal provision would lead to disastrous consequences such as the incident in Sivakasi in Virudhunagar district, where nine people died reportedly due to asphyxiation in a scan centre functioning close to a fireworks shop which caught fire due to friction while loading crackers into a van on October 20, Mr. Justice Nagamuthu said: "We cannot allow people to die because of the lacunae in the law.

4.AREA OF STUDY

Destruction pattern

When crackers burst aloud in the neighborhood, their noise reaches you and affects your ears in different ways. Any sound entering the ear passes through the eardrum and then, into the inner ear. Tiny hairs in the inner ear change the sound waves into nerve impulses. The nerves carry these impulses to the brain, where they are interpreted as sound.

Different sounds affect different parts of the ear. This allows the brain to distinguish one sound from another, like vowels from consonants. We are born with about 30,000 hair cells in the inner ear. If some of these cells are destroyed, they are not replaced. The hairs in the inner ear are very sensitive and fragile - and they can be destroyed by loud noise, or by stress of chronic noise.

The loudness of sound is measured in decibels. Normal conversation is of approximately 60 decibels, the humming of a ceiling fan is 40 decibels, while traffic noise can be around 80 decibels. Noise levels greater than 80 decibels can be hazardous. For most people, 120 decibels hurt. Firecrackers can produce sounds from 120 to 140 decibels and thus cause hearing loss. If the noise exposure is repeated, more cells are damaged and the hearing loss becomes thus permanent. If, after exposure to noise, you have a buzzing, ringing, crackling, or roaring sound in your ears, or other people's speech sounds muffled or distorted, then the noise has damaged your hearing. Feelings of ear fullness or pressure may also happen after you hear a loud noise.

5. MATERIAL AND METHODOLOGY

We went to various cracker shop and saw the way they stored firecrackers in shop. We found that there was no particular way of storing specific firecrackers but light firecrackers were grouped and rest of them were kept randomly. They had all types firecrackers in a table for showcasing among which the famous ones were kept in near sight and in centre spot and for selling they had crackers kept aside. The shop which we usually found were small of 10 feet X 10 feet. Also the biggest shop we found was of dimension 20 feet X 25 feet

The various models used for the calculation of impulse and intensity of sound is done through various models including the TNT equivalence model, TNO model etc. It has also been observed that TNT equivalence model and TNO Multi energy model do not consider the sound velocity, whereas the BS/BST model depends on the sound velocity. All the three models can be applied to determine the explosion limits.

6.**RESULT**

This is done for prediction of blast waves, structural response, and used as a basis for handling and storage of fire cracker as well as design of fire cracker facilities. This method assumes that the gas mixture is involved in the explosion and that the explosion propagates in an idealized manner. It is an ideal thermal explosion model which considers explosion as a single entity; the explosive nature is measured in terms of TNT equivalence; TNT Equivalence =Mass of TNT,(g) /Mass of explosive,(g)The various parameters involved in TNT model are peak overpressure, impulse and the scaled distance. The equivalent mass of TNT is given by

W = ŋ MEC/ EC TNT

where, W is the TNT Equivalence, is the empirical explosion efficiency, M is the mass of explosive charge (g), Ec is the heat of combustion of explosion material (J g-1), ETNT is the heat of combustion of TNT (4765 J g-1)

Scaled Range

The scaled range is measured as,

Z =R /W1/3

Where, Z is the scaled range (m), R is the distance (m), W is the TNT Equivalence Weight (g)

Overpressure

The overpressure is measured as (Rui et al 2002),

ΔP = 1.02{(W^1/3)/R}+3.99{(W^2/3)/R}+12.6{(W)/R}

TNT MODEL CALCULATION FOR CONSTANT DISTANCE

Calculation for scaled range

Scaled Range for atom bomb cracker

The scaled range is measured as

Z = R/W^1/3

Where, Z is the scaled range (m), R is the distance (m), W is the TNT Equivalence Weight (g)

R = 3 m

TNT EQUIVALENCE = 0.06

Z = 3/(0.06)^1/3

Z = 7.99 m

Scaled Range for Chinese cracker

The scaled range is measured as

Z = R/W^1/3

Where, Z is the scaled range (m), R is the distance (m), W is the TNT Equivalence Weight (g)

R = 3 m

TNT EQUIVALENCE =0.04

Z = 3/(0.04)^1/3

Z = 8.34 m

Scaled Range for palm leaf cracker

The scaled range is measured as

Z = R/W^1/3

Where, Z is the scaled range (m), R is the distance (m), W is the TNT Equivalence Weight (g)

R = 3 m

TNT EQUIVALENCE =0.03

Z = 3/(0.03)^1/3

Z =9.55 m

TNO Model

TNO model is based on the degree of confinement and is measured on a scale of 1 to 10 (Beccantini 2007, Sochet 2010). The number 10 corresponds to index volume of congested areas i.e. strong detonation and 1 corresponds to uncongested areas, i.e. weak deflagration. It is based on the assumption that blast is generated only when the explosive is partially confined. The parameters that are measured are scaled distance, positive over pressure, duration time and impulse.

Impulse

The impulse is given by,

$I = (1/ 2 \times P \times T)$

where, T is the positive duration time (s), P is positive overpressure (bar).The results have been analyzed for this model using various firework mixtures. The distance from the centre of the explosion to the point where the explosion takes place is kept as 5-25 m (5, 10, 15, 20, 25 m respectively). The ambient pressure is 1.0132 bar.

TNO MODEL CALCULATIONS

Calculation for impulse atom bomb

The impulse is given by

$I = (1/ 2 \times P \times T)$

where,

T is the positive duration time (s), P is positive overpressure (bar)

Positive duration time = 424.6 s

Positive overpressure = 26.30 bar

I = (1/2×424.6×26.30)

I = 5583.5

Calculation for impulse for Chinese crackers

The impulse is given by

I = (1/ 2 × P ×T)

where,

T is the positive duration time (s), P is positive overpressure (bar)

Positive duration time = 216.65 s

Positive overpressure = 16.95 bar

I = (1/2×216.65×16.95)

I = 1863.11

7. **CONCLUSION**

The TNT equivalence technique is used as a standard tool to evaluate thermal explosion parameters. The Multi Energy Models are alternative methods to TNT equivalence and a study of these models has been conducted using the Thermal explosion data obtained from the Accelerating Rate Calorimeter. TNT equivalence model compares the output of a given explosive to that of TNT explosive. The TNO Multi energy model and BS/BST model consider the obstacles or obstructions present within the explosion region and have been applied as dust explosion models with the available data. However, it is difficult to compare all the three models directly, as they are based on different assumptions and the parameters vary respectively. The overpressure and scaled distance are important parameters in estimating the explosive potential of various firework mixtures. From this study it has been observed that the firework mixtures, under certain conditions can be equivalent to an explosive and hence have to be handled carefully. It has also been observed that TNT equivalence model and TNO Multi energy model do not consider the sound velocity, whereas the BS/BST modeldepends on the

sound velocity. All the three models can be applied to determine the explosion limits. In summary, Pressure rises due to thermal decomposition of fireworks.

- Overpressure decreases with increase in distance.
- TNT equivalence of fireworks mixture varies with different weights.
- The damage causing ability of the fireworks depends on the initial mass and it decreases with distances.
- The studies confirm that the damage causing ability of the blast on structures due to explosive decomposition of fireworks increases with increase in over pressure.

8. **REFERENCE**

- Abdulwadud O, Ozanne-Smith J (1998) Injuries associated with fireworks in Victoria: an epidemiological overview. InjPrev 4:272–275
- Berger LR, Kalishman S, Rivara FP (1985) Injuries from fireworks. Pediatrics 75:877–882
- Barhanpurkar S, Kumar P, Kapadia P (2005) Profile of fireworks related ocular injuries (FROI) from western India. Indian J Community Med 30:98–99
- Smith GA, Knapp JF, Barnett TM, Shields BJ (1996) The rockets' red glare, the bombs bursting in air: fireworks-related injuries to children. Pediatrics 98:1–9
- American Academy of Pediatrics (2001) Committee on injury and poison prevention. Fireworks-related injuries to children. Pediatrics 108:190–191
- See LC, Lo SK (1994) Epidemiology of fireworks injuries: the National electronic injury surveillance system, 1980–1989. Ann Emerg Med 24:46–50
- Mohan K, Dhir SP, Munjal VP, Jain IS (1984) Ocular fireworks injuries in children. Afro-Asian J Ophthalmol 2:162–165
- Singh DV, Sharma YR, Azad RV (2005) Visual outcome after firewoVernon SA (1988) Fireworks and the eye. J R Soc Med 8:569–571

"Special System for Explosion Damage Control"

1.Pankaj Shukla, 2. Rehmat Ali, 3. Shashank Khatri, 4. Shivam Khandelwal, 5. Shubham Khatri, 6. Virendra Singh Songara

Department. of Fire Technology & Safety Engineering, Institute of Engineering and Science, IPS Academy Indore-452012 (M.P.) India

Manish Dubey (Associate Professor)

Department. of Fire Technology & Safety Engineering, Institute of Engineering and Science, IPS Academy Indore-452012 (M.P.) India

---

ABSTRACT

Refinery operation is highly hazardous in nature due to the inherent processes involved and the large inventories of hydrocarbon stored in the premises. Although there are numerous measures in place for risk mitigation, a well-defined and systematic approach is necessary to Deal with any eventualities that may still occur. This contingency plan is developed towards achieving this objective.

It deals with various types of incidents that can occur in the refinery facilities and describes the strategies to contain them effectively For avoiding fire /emergency in petroleum refinery, storage and handling areas, Oil Industry Safety Directorate (India) and National Fire Protection Association (NFPA) has implemented some codes and standards with operational procedures to ensure the safety Therefore, it is necessary to adopt a vigilant fire safety design (Active and Passive) to meet the national and international standards fire protection, firefighting and rescue operation in the event of emergency In petroleum refinery, various hydrocarbons, both liquid and gaseous are handled.

These hydrocarbons are flammable and explosive in nature and volatile to varying degrees depending upon their operating conditions. As the process operations are carried out at elevated temperatures and pressures, they offer high risk of fire and explosions and therefore it is imperative that proper safety precautions are taken in carrying out operations safely and

prevent incidence of fires and explosions. For these reasons, it is absolutely necessary that all people are fully familiar with the hazards involved in day-to-day operations with hydrocarbons and various chemicals and flow safety aspects and regulations with respect to fire prevention, protections and firefighting This project has been prepared mainly to familiarize all students regarding fire hazards involved, their prevention and protection measures, availability of firefighting equipment's and their uses regarding bulk petroleum storage tanks.

1. Main text

In this research paper we have designed a special system to control damage due to explosion using ALOHA. Explosions in industry are accidents caused by a major trolled release of energy. Explosions cause devastating damage, death, and destruction. They may or may not be accompanied by fire damage. Since explosions are the most destructive industrial accidents, design and loss prevention engineers devote extensive effort to explosion damage control.

There are at least two fundamental approaches to the problem of control of explosion damage. The first and best prevention of the explosion. This gives total damage control by eliminating the cause of damage. Explosion prevention is always the desired objective and the best approach to damage control. There are several factors or elements of explosion prevention that will be covered in this chapter.

Explosion prevention measures for combustion explosions are covered in depth in national and international rules and regulation like OISD, Indian standards, NFPA, Standard on Explosion Prevention Systems. Approaches that will be included in this chapter are prevention by elimination of ignition, by oxidant concentration reduction, by combustible concentration reduction, and by suppression of the combustion to prevent pressure rise and resulting explosions.

ALOHA (Aerial Location Hazardous Atmosphere) Modeling

It is a stand-alone software application developed for the Windows and Macintosh systems. It was developed supported by the Emergency Response Division a division within the National

Oceanic and Atmospheric Administration (NOAA) in collaboration with the Office Emergency Management of the Environmental Protection Agency (EPA).

Its primary purpose is to provide emergency response personnel estimates of the spatial hazards associated with chemical spills. The ALOHA development team also recognizes that ALOHA can be an appropriate tool for training and contingency movies at the spatial extent some of the hazards associated with the short-term but users should remain aware of its primary nurse in spill response. ALOHA accidental release of volatile and flammable chemicals. ALOHA deals specifically with human health hazards associated with inhalation of toxic chemical vapors, thermal radiation from chemical fires, and the effects of the pressure wave from vapor-cloud explosions

Since ALOHA is limited to chemicals that become theme. It includes models to assess the rate at which a chemical is released from containment and Vaporizes. These source strength models can be critical components in the process of assessing hazards. ALOHA link source strength models to a dispersion model to estimate the spatial extent of toxic flammable vapors, and explosive vapor clouds However. ALOHA does not model all combinations of source strength, scenario, and hazard category for combustion scenarios. They must choose a specific combination from a limited selection Table shows the combination of source strength models, scenarios, and hazard categories allowed in ALOHA.

ALOHA uses a graphical interface for data entry and display results. The area where there a possibility of exposure to toxic vapors flammable atmosphere, overpressure from a vapor cloud explosion, or thermal radiation from a fire are represented graphically as threat zones Threat zones represent the area within which the ground-level exposure exceeds the user-specified level of concern at some time after the beginning of a release. All points within the threat one experience a transient exposure exceeding the level of concern at some time following the release it is a record of the predicted peak exposure over time. In some scenarios, the user can also view the time dependence of the exposure at specified points.

Objective:

1. To reduce explosion damage in storage tanks.
2. To study various zones created in a explosion.

3. To mitigate its after effects.

MATERIAL AND METHODS

Study area details

ALOHA uses a graphical interface for data entry and display results. The area where there a possibility of exposure to toxic vapors flammable atmosphere, overpressure from a vapor cloud explosion, or thermal radiation from a fire are represented graphically as threat zones Threat zones represent the area within which the ground-level exposure exceeds the user-specified level of concern at some time after the beginning of a release. All points within the threat one experience a transient exposure exceeding the level of concern at some time following the release it is a record of the predicted peak exposure over time. In some scenarios, the user can also view the time dependence of the exposure at specified points.

Methodology

- Rim seal or storage tank fire or leakage from valve
- Detectors and Sensors detect the deviation and send the signal to fire control room
- Actuation Signal from control room to SOV mounted on Drain valve installed above water level
- Starting of Drainage of crude oil from the tank through drain valve
- Shut-off of SOV operated drain valve after temperature sensing by a thermo-sensitive device installed around the tank surface.

RESULT:

ALOHA deals specifically with human health hazards associated with inhalation of toxic chemical vapors, thermal radiation from chemical fires, and the effects of the pressure wave from vapor-cloud explosions. ALOHA uses graphical interface for data entry and display of the area where there is a possibility of exposure to toxic vapors, flammable atmosphere, overpressure from a vapor cloud explosion, or thermal radiation from a fire are presented graphically as threat zones Threat zones represent the area within which the und level

exposure exceeds the user-specified level of concern at some time after the beginning of a release. All points within the threat zone experienced a transient exposure exceeding the level of concern at some time following the release; it is a record of the predicted peak exposure over time.

CONCLUSION:

The application of computational fluid dynamic codes such as REAGAS and BLAST are shown to contribute to a more and more sophisticated approach in vapour cloud explosion hazard analysis. The development of a data base containing data on both vapour cloud explosion incidents and gas explosion experiments (small and full-scale). A further development of software for the computational simulation of the process of turbulent premixed combustion in gas explosions and blast effects. The multi-energy concept applies only if the possibility of unconfined detonation can be ruled out. Therefore, the confidence in the multi-energy method for vapour cloud explosion blast modeling will increase substantially if the conditions under which the possibility of unconfined vapour cloud detonation should be considered, are further specified. Since most LPG Fires originates as a small fires that become increasingly more dangerous the use of the three primary methods to apply water in a quick manner can help reduce the risk of LPG vessel failure. The deployment of portable monitors and hoses, although not one of the three primary methods of water application is an important backup to the primary method. LPG fires can escalate quickly and lack of manual suppression activities by the Fire department can lead to vessel failure It is necessary however to take control of the fuel source before attempting to suppress the Fire. In any case an emergency response plan, along with proper training and Drill, is important to reduce the risk of injuries and promote a quicker and safer response.

REFERENCES

Research Papers

[1] Research on assessment method of fire protection system, by Guangdong technology center of work safety, et al. (2004)

[2] Study Of Fire System To Extinguish Full Surface Fire Of Large Scale Floating Roof Tank, by State Key Laboratory of Chemicals Safety and Qinlylao Safety Engineering Institute; China (1999)

[3] Protecting Atmospheric Storage Tanks Against Vacuum Collapse, by Michael L Griffin Corporate HSE Department, et al. (2003)

[4] Floating Roof Storage Tank Boilover, by Ibrahim M. Shaluf, Salim A. Abdullah, Abu Dhabi Company for Onshore Oil Operations (ADCO) et al. (2005)

[5] Protection Of Large Flammable Storage Tanks During Repair By Means Of Nitrogen-Filled High Expansion Foam, by A.A. brigs Fite Research Station. Building Research Establishment and Borcham wood, Great Britain (1987)

[6] Study Of Fire Fighting System To Extinguish Full Surface Fire Of Large Scale Floating Roof Tanks, by State Key Laboratory Of Chemicals Safety And Qingdao Safety Engineering Institute China (2000)

[7] Protecting Atmospheric Storage Tanks Against Vacuum Collapse, by Michael L Griffin Corporate HSE Department, the Procter and Gamble Company and Sharon Woods Technical Center, Heekin Building, USA(2007)

[8] Protection Of Large Flammable Storage Tanks During Repair By Means Of Nitrogen-Filled High Expansion Foam, by A.A. Briggs, Fire Research Station, Building Research Establishment Borehamwood, Great Britain(2001)

[9] Quantitative Fire Hazards Analysis - An Overview Of Needs, Methods And Limitations, by Edward K. Budnick, Center for Fire Research, National Bureau of Standards, Gaithersburg, U.S.A(1997)

[10] Experimental Studies On Temperature Rise Within A Hydrogen Cylinder During Refueling, by Institute of Process Equipment, Zhejiang University, Hangzhou 310027, China, et al (1985)

Books

[11] Fire Protection Handbook, by NFPA Vol.1, pp-321-560

[12] Fire Protection Handbook, by NFPA Vol.2, pp-233-561

Online Resources

"Rim Seal Protection System for Storage Tank in Refinery Division"

1.Shubham Dixit, 2. Piyush Raj, 3. Rajneesh Kumar Thakur, 4. Vivek Krishan Satyam, 5. Ujjwal Kumar, 6. Priyansh Khandelwal, 7. Rahul Singh

Assistant professor Mr. Manish Dubey

Department of Fire Technology and Safety Engineering, IES, IPS Academy, Indore Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

ABSTRACT

Floating roof storage tanks being the most important part of petroleum refineries and are used to store volatile liquids hence to keep them safe and away from hazards like fire incident we have designed a rim seal foam package system for it that automatically detect and control fire in incipient stage.

This paper presentation provides an over view of foam package system for floating roof tanks, system application rate, design criteria with which foam is thoroughly applied on rim seal area. We also discuss in brief about various supplier of rim seal.

1. INTRODUCTION

- **RIM**: Any object whose outer edge is circular.
- **SEAL**: A substance used to join two things so as to prevent anything anything passing between them.
- **FOAM PACKAGE:** Pre mix foam solution pressurized inside the cylinder.
- **RIM SEAL FOAM PACKAGE SYSTEM**: Is a fixed automatic fire detection and extinguishment system in the event of fire on floating roof tank.

Fig.1.1 rim seal foam package system

2. LITERATURE REVIEW

1. Fei-Fie zhang, Hai-ling jiang and Cheng zhang (2014) has done research paper on "Study of charging of nitrogen to external floating roof tank to prevent Rim seal fire from lightning"

It is estimated that 95% of rim seal fire is caused by lightning striker. To avoid rim seal fire caused by lightening the existing method mainly focus on the use of secondary sealing to reduce volatilization of oil and the electrical connections measures such as terminals, deflectors, grounding device discharge shunts, and scalable grounding devices to avoid spark caused by lightning current. but these device can not eliminate the spark generation thoroughly. A new method of charging nitrogen to external floating roof tank seal ring is proposed to prevent rim seal fire from lightning

2. Mi-Ae Moon, Chung-Suk Lee,andKwang-Yong Kim (2014) has done research on " Effect of a rib on rim seal performance"

The effect of a rib installed in a rim seal on sealing effectiveness was investigated using three-dimensional Reynolds-averaged Navier–Stokes analysis. A parametric study was performed for a single square rib installed on the surface on the rotor side. A total of 12 cases were tested with different heights, widths, and locations of the rib. The Spalart–Allmaras model was adopted as a turbulence closure model. The Reynolds number based on the axial chord of blade was 500,000 at the mainstream outlet. Ratio of the mainstream outlet velocity to mainstream inlet velocity was kept constant at 3.10. The sealing effectiveness was selected as the performance parameter. Installation of a rib in the rim seal enhances sealing performance

regardless of the dimensions and location of the rib, although the effects are relatively small in some cases where the rib is located far from the surface of the rim seal on the rotor side.

3. H.su and R.Rahmani (2016) has done research paper on" Thermo hydrodynamics of bidirectional groove dry gas seals with slip flow"

Thermo-hydrodynamic behavior of bidirectional dry gas seals with trapezoidal shaped symmetric grooves is studied. A multi-physics model, coupling compressible laminar flow and heat transfer in both the fluid and the solid bodies is used in a multi-physics modeling environment. The multi-physics model also includes slip flow conditions, corresponding to relatively high Knudsen numbers, as well as the effect of asperity interactions on the opposing seal faces. A comparison of the seal performance under isothermal and thermal flow conditions shows the importance of including the thermal effects. The difference in the predicted opening force between isothermal and thermal model can exceed 2.5%, which is equivalent to a force of around 1 kN.

4. XingyunJia, Hai Zhang, and Yuting Jiang (2018) has done research on "radial–axial clearance rim seal in realistic working conditions"

Performance of radial–axial clearance rim seal (RACS) in realistic working condition is investigated and compared with axial-clearance rim seal (ACS), radial-clearance rim seal (RCS) in this paper. Authors use the numerical method of conjugate heat transfer for calculation to accurately take heat transfer between the rotor–stator cavity flow and the solid discs into account. Results show that seal effectiveness and cooling effectiveness of RACS are the best when compared with ACS and RCS, the minimum mass flow rate for seal of RACS is 75% of that of RCS, and 34.6% of ACS.RACS has higher air-cooled aerodynamic efficiency, minimizing the mainstream performance penalty when compared with ACS and RCS. Corresponding to the respective minimum mass flow rate for seal, the air-cooled aerodynamic efficiency of RACS is 23.71% higher than that of ACS, and 12.79% higher than the RCS. Finite element analysis in turbine disc shows that RACS minimizes the flow rate of cooling air required for suppressing the radial growth of turbine disc in the three rim seal types. Mass flow rate of the required cooling air of RACS is approximately 40.9–52.9% of that of ACS, and 70–75% of RCS.

3. STUDY AREA

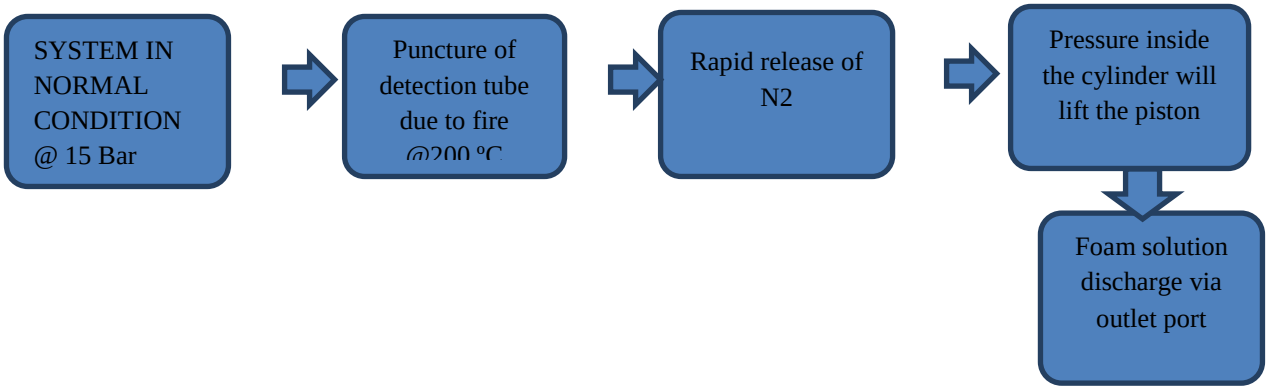
Using of rim seal foam package system is used to prevent rim seal fire in initial stage so that fire may not spread. For example, RIL, IOCL, HPCL and BPCL, Etc, stores volatile liquid in a floating roof tank and distributed by using pipelines. Hence there is chance of fire over rim seal fire because flammable vapor are present. In this project we have taken data of rim seal foam package system of reliance industries limited to understand how actually rim seal foam package system works. what are the parts of rim seal foam package system?

We have taken data of the reliance industry where foam package system called fitech was installed.

3.1 SYSTEM COMPONENTS:

1. Foam package cylinder
2. Schrader valve
3. Sun shield
4. Instrument control panel
5. Junction box, PSL and PSH
6. Balanced pressure valve
7. Pneumatic detection Impolene tube
8. Discharge nozzle

3.2 FUNCTIONAL DISCRIPTION



4. MATERIAL AND METHODOLOGIES

4.1 WHY RIM SEAL FOAM PACKAGE SYSTEM

As per OISD 116 rim seal foam package system should be installed

1. Before 2007 criteria for installation of rim seal foam package system was on all floating roof tank having diameter more than 60M
2. But again, the amendment of 2010 of OISD 116, it has been declared that automatic foam package detection and extinguishing system shall be provided on all existing as well as on new external floating roof tank storing class 'A' petroleum product
3. Foam solution application rate should not be less than (minimum) 18lpm/m sq.
4. Duration of discharge should not be less than (minimum) 40 sec.
5. Storage tanks storing class 'B' and class 'C' petroleum product having diameter above 60m.

4.2 CERTIFICATION BY:

These detection systems shall be certified by any of the international certifying agencies like UL, FM and LPC to ensure that those systems are used which meet with highest international standards of safety certification.

4.3 SYSTEM DESIGN & CALCULATION

- Diameter of tank = 92mtr
- Rim seal = 300 mm wide
- Foam solution application rate = 18LPM/M²
- Duration of discharge =40 sec

- Rim seal area of tank = 3.14×92×.3 = 87m²
- Rate of foam application

(@18lpm/sq. mtr) = 87×18 = 1566 LPM

- Total foam solution = (1566×40) / 60
- Required for 40 sec = 1044 lit.

NOTE: The coverage of module differ according to vendors so capacity of each module will also vary as per coverage.

5. RESULT

From the calculation we have got the following outputs:

1. The foam application rate should not be less than 18 lpm/m sq. of any foam system and if it is less than 18lpm/m sq. than that system should not be installed as per OISD 116.
2. The minimum discharge time should not be less than 40sec. of any foam system and if it is less than 40sec. than that system should not be installed as per OISD 116.
3. The foam solution required pre foam package system depends upon the rim seal area i.e. more the rim seal area more foam solution required.
4. Only single module actuates if fire occur in that coverage area.

6. CONCLUSION

Rim seal foam package system also called automatic fixed extinguisher system or automatic shoot fire system installed over the refineries tank that store volatile liquids plays an important role to prevent fire over rim seal areas.

By working on the project topic rim seal foam package system on a refineries tank re we have found the following conclusion.

1. If rim seal foam package system installed over the floating roof tank than it will give time to fire man to take some action.
2. It will initially prevent the spreads of fire.
3. If in case fire occurs over rim seal area than it will also give signal to F&G control by which immediate action can be taken.

7. REFERENCES

1. OISD: 116 - “fire protection facilities for petroleum refineries and oil/gas processing plant”

2. OISD: 117 - “fire protection facilities for petroleum depots, terminals, pipelines installations and lube oil installations”

3. OISD: 129 - “Inspection of storage tanks”

4. IS: 4989 - “foam concentrate for producing mechanical foam for firefighting specification”.

"Electrical Fire Risk Assessment in Chemical Process Plant"

1.Sandarbh Sharma, 2. Vikas Dagdi, 3. Tabib Khan, 4. Sanket Chadar, 5. Vishal Gupta, 6. Pradeep Kumar

Department. of Fire Technology & Safety Engineering, Institute of Engineering and Science, IPS Academy Indore-452012 (M.P.) India

Sourabh Jain (Assistant Professor)

Department. of Fire Technology & Safety Engineering, Institute of Engineering and Science, IPS Academy Indore-452012 (M.P.) India

ABSTRACT

Electricity distribution system risk assessment describing the different risk consequence categories which are relevant in the whole risk picture with regards to their characteristics, their type of impact and applicable risk analysis methods. The paper illustrates that distribution system asset management constitutes of a variety of more or less conflicting objectives and that there is no single risk assessment method which cover all the different aspects of distribution system risk. HIRA involves many techniques ranging from simple quantities methods to advanced quantitative method are available to help identity & analyses hazard. The high-risk activities have been marked acceptance & must be reduced the risk which are marked in yellow color are tolerable but effort must be made to reduce risk without expenditure that is grossly disproportionate to the benefit gained.

Pyro Sticker is a flexible plate of composite fire suppressing material carried by self- adhesive substrate. Method of mounting – gluing horizontally over a potential source of ignition. ACTOK Indonesia Pyro Sticker is a miniature self-contained, automatic local fire suppression installation, designed with application of ACTOK Indonesia technology. Intended for protection against inflammation of electric sockets, junction boxes, power distribution boards (electric cabinets) and other electrical equipment having confined space of 0.02 to 60 dm3.Pyro Cord is a new generation of fire suppressing products, a cord of composite material being a

mixture of microcapsules with a heating compound. Pyro Cord is placed within the protected local space so that it is located over each potential source of inflammation.

1. INTRODUCTION

The success rate of an industry can not only be judged by its production and profit value per year, but it also requires a prominent level of safety and its related standards so that any malfunctioning of any type of equipment, device, process or even in worker cannot turn into a big hazard [1]e risks associated with the chemical industry are commensurate with their rapid growth and development. Apart from their own inherent properties and hazards like flammable, explosive, toxic, corrosive etc. Electrical fires are those which are directly caused by the flow of electric current or by static electricity is one of the important types of structure fire. The subsequent development of an electrical fire is generally not different than that of any other fires, but the mechanisms leading to ignition of an electrical fire are in any cases, uniquely specialized and in need of special research to delineate their characteristics. Chemical industries are exposed to fires and explosion hazards due to combustible properties of the processed chemicals. As per the statistics, for a period of 5 years 42% of major accidents were only due to fire. While analyzing the probable causes for fires and explosions electrical reasons are undoubtedly the top among the most probable causes. Hence electrical safety deserves maximum attention especially in hydrocarbon industry where classified hazardous atmosphere is normally encountered and electricity constitutes one of major source of ignition that could cause a fire or an explosion. Hazard identification and risk analysis (HIRA) involves identification of undesirable events that leads to a hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects. A HIRA is a risk assessment tool that can be used to assess which hazards pose the greatest risk in terms of how likely they are to occur and how great their potential impact may be. It is not intended to be used as a prediction tool to determine which hazard will cause the next emergency. The objective of HIRA is to identify and evaluate the hazards and unintended events, which could cause accident. In this process, it is generally assumed that the plant will perform as designed in the absence of unintended events which may affect the plant/process behavior. Prevention of human and property losses is integral to the

operation and management of Chemical Process Plants[2]. This may be achieved through the selection of a technology that is inherently safe. Alternatively, safety of plant design and operation can be audited by the application of HIRA techniques and adopting measures suggested by the analysis. The letter approach may constitute quantitative risk analysis (QRA).

2. LITERATURE REVIEW

Jahangiri et al. (2015) describes their work as a permit to work (PTW) is a formal written system to control certain types of work which are identified as potentially hazardous.

Enescu et al.(2014) describes their work as Risk management is a key component of strategic management in any organization

Meel et al. (2007) describes their work as classical statistical approaches are ineffective for low frequency, high consequence events because of their rarity

Gejawski et al. (1996) describes their work as This paper presents experimental results of research on the electrical

Jahangiri et al. (2015) describes their work as a permit to work (PTW) is a formal written system to control certain types of work which are identified as potentially hazardous.

Enescu et al.(2014) describes their work as Risk management is a key component of strategic management in any organization

Meel et al. (2007) describes their work as classical statistical approaches are ineffective for low frequency, high consequence events because of their rarity

Gejawski et al. (1996) describes their work as This paper presents experimental results of research on the electrical

Vercoulen et al. (1993) describes their work as electrical, inductive, non-intrusive probes are employed for measuring the electric charge

Yan et al. (1993) describe their work as theoretical and experimental studies of cross correlation techniques applied to non-restrictive velocity measurement of pneumatically conveyed solids using ring-shaped electrodynamic flow sensors are presented.

3. OBJECTIVE

1. Review of literature on HIRA
2. Review of accidents in chemical process plant due to electricity.
3. Study of risk assessment methodologies.
4. Applications of HIRA for improvement of workplace safety in chemical plant.

4. MATERIAL AND METHODS

4.1 Study area details

Gujarat Narmada Valley Fertilizers & Chemicals Limited (GNFC), is a joint sector enterprise promoted by the Government of Gujarat and the Gujarat State Fertilizers& Chemicals Ltd. (GSFC). It was set up in Bharuch, Gujarat in 1976. Located at Bharuch in an extremely prosperous industrial belt, GNFC draws on the resources of the natural wealth of the land as well as the industrially rich reserves of the area. GNFC started its manufacturing and marketing operations by setting up in 1982, one of the world's largest single-stream ammonia-urea fertilizer complexes. Over the next few years, GNFC successfully commissioned different projects-in fields as diverse as chemicals, fertilizers and electronics.

4.2 Methodology

Fault tree analysis (FTA) is a top-down, deductive failure analysis in which an undesired state of a system is analyzed using Boolean logic to combine a series of lower-level events. This analysis method is mainly used in the fields of safety engineering and reliability engineering to understand how systems can fail, to identify the best ways to reduce risk or to determine (or get a feeling for) event rates of a safety accident or a particular system level (functional) failure. FTA is used in the aerospace, nuclear power, chemical and process, pharmaceutical, petrochemical and other high-hazard industries; but is also used in fields as diverse as risk factor identification relating to social service system failure. FTA is also used in software engineering for debugging purposes and is closely related to cause-elimination technique used to detect bugs. The fault tree analysis (FTA) was first introduced by Bell Laboratories and is one of the most widely used methods in system reliability, maintainability and safety analysis.

It is a deductive procedure used to determine the various combinations of hardware and software failures and human errors that could cause undesired events (referred to as top events) at the system level. The deductive analysis begins with a general conclusion, then attempts to determine the specific causes of the conclusion by constructing a logic diagram called a fault tree. This is also known as taking a top-down approach. The main purpose of the fault tree analysis is to help identify potential causes of system failures before the failures actually occur. It can also be used to evaluate the probability of the top event using analytical or statistical methods. These calculations involve system quantitative reliability and maintainability information, such as failure probability, failure rate and repair rate.

5. RESULTS

The result obtained in two tables in (table-1) we got the minimum ignition energies for some common combustible vapors and gases and in (table-2) we got the minimum ignition energies for some combustibles dust clouds which as follows: -

Table 5.1 Minimum ignition energies for some common combustible vapour and gases

Vapour	**mJ**	**Vapour**	**mJ**
Acetone	1.15	Isopropanol	0.65
Carbon disulphide	0.01	Acetylene	0.02
Diethyl ether	0.19	Butane	0.25
Ethyl acetate	1.42	Propane	0.25
Heptanes	0.24	Ethylene	0.07
Hexane	0.24	Ethylene	0.06

		oxide	
Methanol	0.14	Hydrogen	0.02
Methyl ethyl	0.53	Methane	0.28

Fires and explosions are serious hazards in the process industries. Mitigation methods, such as suppression and venting, can be expensive. Ideally, the best option would be to avoid fire or explosion, which may be accomplished by either removing the explosible fuel/oxidant mixture, or the ignition source

Table 5.2 Minimum ignition energies for some combustible dust clouds

Material	**mJ**	**Material**	**mJ**
Aluminium powder	10	Phthalic anhydride	15
Aspiren	16	Pitch	20
Benzoic acid	12	Polycarbonate	25
Calcium stearate	15	Poly ethylene	10
Capro lectam	60	Polypropylene	30
Cellulose	40	Polystyrene	15
Cocoa	120	Rubber	50

Cork	35	Sodium acetate	35
Epoxy resin	9	Stearic acid	25
Lignin	20	Sugar	30
Lignite	30	Sulphar	15
Magnesium	40	Thorium	5
Nitro cellulose	30	Titanium	15
Nylon	20	Urea formaldehyde resin	34
Paper	60	Vitamin C	60
Perspex	15	Wheat flour	50

6. CONCLUSION

It would be quite impossible to fully do justice to the diversity of applications, problems and hazards arising from static electricity in such a short document. However, it is to be hoped that whichever aspect of electrostatics is relevant; enough will be found in these pages to at least provide grounding. For many situations that may be enough. For others it may be enough to indicate the complexity of the phenomena involved and point to the need for further reading. For some it may even awaken ideas of new beneficial applications of static electricity, or a

hitherto unthought-of mechanism for a particularly intractable problem and the need to talk to an expert to take it any further. Whichever it is, it is to be hoped that what has been found in these pages has proved interesting.

This has been an overview covering many of the electrostatic issues we encounter in our visits to industry. We have also explained how it can be used in practical applications such as photocopying and how it can pose a hazard in many industrial processes. We have aimed to provide an understanding of the complex nature of electrostatics but, as in all areas of technical knowledge, it is often necessary to obtain assistance from the experts.

7. REFERENCES

1. Marian Enescu (2014),"Point of view regarding the evaluation of decisional factors in risk management associated to large combustion plants", *Sciencedirect*, Vol 16, PP.110- 114.

2. Kiyoshi OTA (2004),"Evaluation and prevention of electrical hazards in chemical process plant", *Process & Production Technology Center,* Vol 2, PP. 1-12.

3. Xuanya Liu (2013),"Petrochemical Plant multi – objective and multi stage fire emergency management technology system based on the fire risk prediction", *Procedia Engineering,* Vol 62, *PP.1104*-1111.

4. NFPA 70® (NEC®). The National Electrical Code® is referenced by all of the building and fire codes in the United States

5. Cawley JC, Homce GT (2006). Trends in Electrical Injury in the U.S., 1992-2002. In Proceedings of the IEEE Petroleum and Chemical Industry Committee Annual Conference, Philadelphia, PA, September 11-1, 2006, IEEE, 325-328.

6. Cawley JC (2011). Occupational Electrical Accidents in the U.S., 2003-2009. ESFI WhitePaper.Availableat:
http://www.esfi.org/index.cfm?pid=11406&view=list&sb=date&st=desc&m=0&y=0&
type1=0&type2=20&change=View. Accessed November 8, 2014.

7. McMann M, Hunting KL, Murawski J, Chowdhury R, Welch L (2003). Causes of Electrical Deaths and Injuries Among Construction Workers. American Journal of Industrial Medicine 43:398-406.

8. Singh S 1982 A study of electrostatic activity in a full scale pneumatic conveying system Proc. Intl. Conf. on Pneumatic Conveying Tech., Stratford-upon-Avon UK.

9. R.G. Horn, D.T. Smith, A. Grabbe, "Contact electrification induced by monolayer modification of a surface and relation to acid-base interactions" Nature 366, 422 (1993)

10. J.A. Wiles, M. Fialkowshi, M.R. Radowski, G.M. Whitesides, B.A Grzybowski, "Effects of surface modification and moisture of the rates of charge transfer between metals and organic materials" J. Phys. Chem. B 108, 20296 (2004).

11. Pyrosecure.in(2016) the website which gives the detail of the Pyrostickers And Pyrochords

"Forest Fire Early Detection and Online Remote Monitoring Using Sensors"

1.Parixit Niwadunge, 2. Pritam Kumar, 3. Priyam Songara , 4. Rajesh Kumar,
5. Ronit Gehlot, 6. Vivek Kanade

Mr. Sourabh Jain, Assistant Professor

Department of Fire Technology and Safety Engineering, IES IPS Academy, Indore (M.P)

ABSTRACT

Forest fire sensor networks constitute a powerful technology especially suitable for environmental monitoring. With regard to wildfires, in particular, they enable low-cost surveillance of hazardous locations like wild land urban interfaces. This report presents the work developed during the last four years targeting a forest fire sensor network node for the reliable, on-site detection of forest fires. The tasks carried out ranged from detecting or sensing of conditions that rise to a forest fire, this process is a complex one carried out basically in 3 phases namely:

1) Detection/sensing of the flame through IR sensor and smoke through MQ2 sensor.

2) Transfer of the collected information to a remote location through a network using a communication protocol like GSM.

3) Receiving of the transferred data by a suitable platform/operating system that can showcase that data in a normally understandable format giving indication about the environment condition on that particular region.

1 INTRODUCTION

One of the new risks is linked to an increase in fire calamities, which possibly could cause negative feedbacks to the global carbon cycle, impair ecosystems functions, cause human casualties, and destroy valuable human assets. Thus, in order to attain sustainable development goals, the management of many observation subsystems in a coherent, efficient, and effective manner is needed.

[1] The use of sensor networks covering large territories to ensure the effective monitoring of such phenomena as wildfires remains to be a problem of particular interest and significance [2].There are currently a number of approaches to address this problem. However, from a technical point of view, it has not been completely and effectively resolved as yet [3]. Traditionally, the monitoring task was performed by a specially trained team in a lookout tower located at a high point [4]. This method of monitoring is still applicable in some countries, such as the US, Canada, and Australia. Due to unreliability of human observations, some vision techniques have been proposed to monitor small forests from the tower [5]. Satellite imaging, for example, though able to ensure sensing of vast areas, has, as a method, considerable restraints in terms of real-time spatial resolution and sensitivity. In addition, it is associated with the exceptionally high deployment and operational costs, which make it difficult to use in all cases [6, 7]. Another widely applied method of monitoring wildfires or gas leakages is based on getting data on the emissions source. The ultra sensitive devices installed aboard the airplanes, trailers, and other vehicles enable the acquisition of data in cross patterns [3]. This approach requires the availability of operators and maintenance personnel. Its main shortcoming, however, is that spatial and time resolution is limited to a point measurement at the vehicle current location. Apart from that, in the case of using airborne platforms their ultrahigh sensitivity should be provided to detect ground emissions after the gases have propagated to a considerable distance from the sources. In order to simplify and reduce the costs of fire monitoring, the concept of Wireless Sensor Networks (WSNs) [8] has been recently proposed. Cheap and compact wireless sensor devices deployed over a large territory and operating both jointly and autonomously may be effectively used to detect hazardous gases and monitor wild-fires [9].Forests Fires is the most universal and most immediate destructive agency. This is usually caused due to carelessness and negligence but exceptionally because of matchsticks, friction of rocks etc. Deliberate fires are called incendiary fires are caused. by grazers of cattle for fresh shoots of grass by poachers who collect Minor Forest Produce (M F P) and occasionally by vandalisms willingly.

1.1 THE CAUSES FOR FORESTS FIRES

1. Less moisture content in the fuel
2. Wind movement
3. Topography
4. Forest cover
5. Debris burning
6. Camp fire or fire used for cooking
7. Incendiary
8. Lighting of match sticks negligently

1.2 TYPES OF FOREST FIRES

Forest fires can usually be divided into three categories namely

1. GROUND FIRES
2. SURFACE FIRES
3. CROWN FIRES

1. GROUND FIRES

These occur in the humus and peaty layers beneath the litter of composed material on the forest floor and produce intense heat but practically no flame. Such fires are relatively rare and have been recorded occasionally at high altitudes in Himalayan fir and spruce forests. This kind of fires is the most difficult to detect because they are undetectable until they blaze up. Generally by the time they are detected, the forest undergrowth is already reduced to ashes, killing all the animals that live underground.

2. SURFACE FIRES

Surface fires, occurring on or near the ground in the litter, ground cover, scrub and regeneration, are the most common type in all fire-prone forests of the Mediterranean countries. In this type, the spread of fire is regular and usually depends on wind speed.

3. CROWN FIRES

Crown fires occur in the crowns of trees, consuming foliage and usually killing the trees, these fires occur most frequently in low level coniferous forests. Crown fires the most dangerous fires for a forest, spread rapidly and widely.

1.3. **MEASURES TAKEN TO PREVENT FOREST FIRES**

The main measures taken to prevent Forest fires are by way of

1. Fire lines
2. Fire walls

1. Fire lines:

Fire lines help to reduce the spread of fire. They are sometimes naturally formed and sometimes artificially chopped stripes of land capable of stopping or checking spread of fires and are being used to fight fires.

2. Fire walls:

The Construction of walls with a width of 3 feet or 4 feet and not less than 5 feet to 6 feet and dividing forest in to sectors is done to control the fire without spreading to the entire area. The wall length depends on the slope of the forest. The cleared materials are burnt or taken away. Firewalls are most effective during the fire season.

2. TYPES OF FOREST FIRE MONITORING AND DETECTION SYSTEMS

In the following subsections, we will briefly review the common approaches to monitoring and detection of forest fires

2.1 WORD-OF-MOUTH FOREST FIRE MONITORING SYSTEM

The word-of-mouth forest fire monitoring system is widely used in the world. It is a human community based bushfire detection system, which utilizes interpersonal communication to transmit forest fire information. Research by the United Nations points out that many human communication chains can be formed through interpersonal communication. These chains would become active in the case of important events. Therefore, if a Forest fire occurs, a

warning message is conveyed through human communication chains and reaches a fire service department or an emergency centre.

2.2 FIRE WATCH-TOWERS FOREST FIRE MONITORING SYSTEM

When forest fire detection system is mentioned, fire watch-towers are most likely to leap to mind. Forest fire watch-towers are constructed in a pyramidal shape to provide stability, with a cabin at the top, where an observer is located to spot fires. The towers are usually 10–20 m high and constructed on flat-topped hills, or 30–40m high are commonly used on fairly flat terrain to provide a good view over the surrounding tree cover. Some equipment is provided in the cabin to facilitate detection, recording of information and communication. When observers detect a fire, they guide the pointer of the azimuth angle and report to a forest division or forest enterprise office by telephone or radio transmitter, an observer detects a fire and notes the azimuth angle of the direction of the fire, then a warning message is sent to the forest division or the forest enterprise

2.3 GROUND AND AERIAL PATROL FOREST FIRE MONITORING SYSTEM

Ground patrolling is carried out by foresters and temporary fireguards. These people undertake forest fire detection, protection and control all round, in addition to their normal and regular duties. A patrol personal communicates the information to a base station, e.g., fire watch-tower, regularly. Therefore, when a forest fire occurs, the patrol personal is in radio contact with fire towers and their headquarters. Aerial patrolling requires hiring an aircraft to watch from the air. Although such approach is expensive, it is commonly used for enhancing other methods of detection. Aerial patrolling is usually used for special purposes, such as to provide an additional detection during fire danger periods. The main working processes of this system starts by the ground or aerial patrolling detection for forest fire, then report to fire watch-tower or forest enterprise office using a radio.

2.4 SATELLITE-BASED FOREST FIRE MONITORING SYSTEM

A report indicates that systems based on space technology can efficiently monitor forest fire because they can locate fire quickly and precisely, in addition to providing extra information, such as temperature. Most of these systems mainly depend on satellites, which include remote sensing technology such as infrared technology. Thus, they are called satellite-based forest fire monitoring systems. Usually, such system consists of two components, satellite and communication network. Their operation process is portrayed as follows. A satellite will monitor ground from space through embedded sensor network, if fire is detected, the satellite will activate forest fire warning sirens. Then, warning messages will travel outwards via communication network, for instance, satellite-computer linkages, ground receiver station, aircraft receiver station, and sea receiver station. Finally, warning messages will be sent to an official department.

3. METHODOLOGY

In our project the system incorporates GSM network, so that the signal could be sent any far distance, where the centralized control centre is located. The proposed system consists of fire & smoke sensors which uses power for its operation and a GSM module which is connected to the GSM network for transmitting the detected fire alarm signal. When fire is detected, the sensor produces a signal of approximate level which triggers GSM module to transmit the alarm signal to far end control center. The center in turn processes the signal and takes necessary action to counteract the situation.

The project consists of constructing a device which can effectively detect forest fire without human intervention. The main component of the project is 1) IR flame sensor which can detect the flame (IR region), 2) MQ2 smoke sensor which detects the smoke in the region and untill both the sensor detects flame & smoke the buzzer doesn't get active and the message isn't send to the concerned authority, although this setting can be changed to sending of notification on detection of either smoke or flame, based on the need. The sensors are powered by any electric power source although it can be upgraded and solar power can also be used it depends on the

nature of the forest region. On detecting forest fire in the initial stage, the sensor sends an alarm signal to the FIRES STATION using GSM.

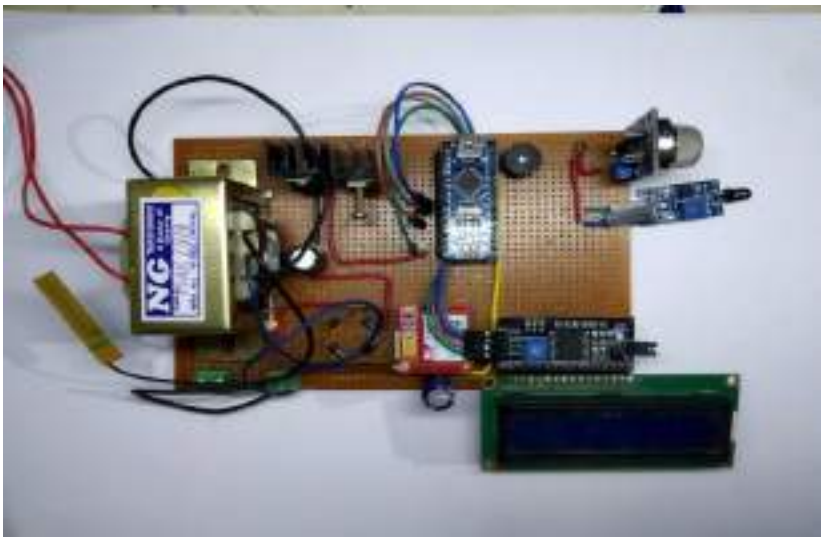


Fig. **Forest Fire Early Detection And Online Remote Monitoring Using Sensors**

The components used are :

1) **MQ2 Smoke sensor**:

The MQ-2 is a flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage.The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm.The MQ-2 gas sensor is sensitive to LPG, i-butane, propane, methane, alcohol, Hydrogen and smoke.They are used in gas leakage detecting equipments in family and industry and in portable gas detector.

2) IR Flame Sensor:

IR flame sensor detects the flame in IR region.

3) GSM module:

GSM module is used to send the information and notification via GSM network.

CONCLUSION:

This paper has provided us an excellent opportunity and experience, to expand our knowledge. This forest fire monitoring system can be implemented in any place where exist a coverage of a GSM network which is where we usually have lives and properties that need

protection. The alarm message is transmitted to the mobile phone or a server; hence a fully automated process with no people is involved. It only takes seconds to switch on the GSM module and make a call as soon as the circuit is closed on detection of fire. Using solar power and advanced IR and smoke sensors can advance the project's level as well as it can reduce the cost of maintaining and operating the system with increased effectiveness and accuracy.

REFERENCES:

[1] Nikolay Khabarov, Elena Moltchanova, and Michael Obersteiner.(2008). Valuing Weather Observation Systems for Forest Fire Management. IEEE SYSTEMS JOURNAL, VOL. 2, NO. 3

[2] Doolin, D.M. and Sitar, N. (2005) Wireless sensors for wildfire monitoring. In Proceedings of Conference on Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, San Diego, CA, USA, 7–10 March 2005, 477–484.

[3] Volokitina,A., Sofronov, M. and Sofronova, T. (2008) Topical scientific and practical issues of wildland fire problem. Mitig. Adapt. Strateg. Glob. Chang. 13(7): 661–674.

[4] Fleming, J. and Robertson, R.G. (2003) The Osborne firefinder. In Fire Management techtips, October 2003, 1–2.

[5] Den breejen, E., breuers, , F., kemp, R.,Roos, M., Schutte, K. and De vries, J.S. (1998) Autonomous forest fire detection. In Proceedings of the Third International Conference on Fire and Forest Meteorology, Luso, Portugal, 16–20 November 1998, 2003–2012.

[6] Leblon, B. (2005) Monitoring forest fire danger with remote sensing. Nat. Hazards 35(3): 343–359.

[7] Burgan, R., Klaver, R. and Klaver, J. (1998) Fuel models and fire potential from satellite and surface observations. Int. J. Wild land Fire 8(3): 159–170.

[8] Chong, C.Y. and Kumar, S.P. (2003) Sensor networks: evolution, opportunities, and challenges. In Proceedings of IEEE 91(8): 1247–1256.

"Industrial Threat Protection System"

Palash Gawte

Fire Technology & Safety Engineering Department, IPS ACADEMY Institute of Engineering & Science, INDORE (M.P)

ABSTRACT

Workers of every types of Industry are exposed to various types of hazards which limits there performance The industrial threat protection system render power to the worker to save not only his but his co-worker life. Generally, Workers face a problem of communicating with others in case of an emergency .The industrial threat protection system solves this problem with great ease by simply pressing a switch. A worker can control complex systems like sprinkler system, heavy electrical machinery etc, by simply pressing a switch on band.

1.INTRODUCTION

Since safety has always been the most important aspect of any process being carried on an industry and keeping the point of safety in mind, the control of hazards can be done by various methods like elimination, substitution, administration control, PPE's(Personal protective equipment). In accordance with these methods, some systems are currently in a position of being introduced in the market and some have been developed earlier like Remotely Controlled Fire Protection System.

Industrial Threat Protection System, an efficient companion for industrial workers to deal with emergency. It is a new generation PPE (Personnel Protective Equipment) for protection against Industrial Hazards. The Industrial Threat protection System operates effectively against electrical hazard & fire hazard. It also solves the problem of workers of communicating with the safety officer in case of an emergency. The purpose of this of this research is as follows; to render power to every individual to safe not only his but his co-worker life too; Revolution in the form of PPE (Personal Protective Equipment):

Giving power to every individual worker to control system of industry by pressing one simple button.

2.Literature Review and problem formulation

In 2010, Paul Morgenstern. Al. [2] introduced a Method and apparatus for remotely controlling a fire protection system for buildings. This method of fire protection uses a wireless or wired control system to remotely activate a fire protection system by sending it an activation signal or activation message wherein one or more commands can configure the system with specified operation instructions. The system utilizes roof top sprinklers and may additionally utilize existing irrigation systems or additional zones only used during the prevention of wildfires to wet down area in advance of fires. This apparatus mainly can be used in residential area, it will not be suitable for industries.

We have introduces a system to survive in industry. The purpose of the wristlet is to render power to every individual worker save not only his own, also his co-worker's life._Whenever there is an emergency, wristlet will alert the safety in - charge of the respective zone and waits till a valid response is received, then take requisite action to counter the emergency. This device utilizes the basic fire alarms, sprinklers and MCB (Main Circuit Breaker) of the concerned zone. But its core feature lies in the fact that this assembly is highly efficient in time, portable, easy to operate and hence desirable.

2.**MATERIAL AND METHODOLOGY :**

The industrial threat protection system consist of modems, which will be installed in every zone of the industry, creating a LAN (local area network) to cover that zone and all the modems collectively will cover the entire industry. Another important component of the system is a safety wristlet which is a type of wrist-band, which consists of a WIFI module (ESP 8266) acting as a transmitter which transmits signals given by the user (worker) through LAN created by the modem to the another WIFI module which acts as a receiver. This Wi-Fi module receives input signal from the Wrist band transmitted through LAN. After receiving the signals the module will transmit it to the microcontroller i.e. Arduino mega 2560 decode the signal & take actions according to it. The microcontroller itself are connected to Sprinkler system, power supply fuse & siren of the zone .Microcontroller will access all these system according to input given to it.

Suppose a worker wants to operate the siren, he will press the switch 1. The ESP module present in the band will transmit the signal to receiver module through the local area network. The receiver then transmits the signal to the micro-controller which will access the information according to the input given and it will operate the siren.

Suppose a worker wants to Cut-off the power supply he will press the switch 2. The ESP module present in the band will transmit the signal to receiver module through the local area network. The receiver then transmits the signal to the micro-controller which will access the information according to the input given and it will operate the fuse to cut-off the power supply.

Suppose a worker wants to operate the sprinkler he will press the switch 3. The ESP module present in the band will transmit the signal to receiver module through the local area network. The receiver then transmits the signal to the micro-controller which will access the information according to the input given and it will operate the sprinkler system of that zone.
Each process independently requires a maximum of 1 second duration time.

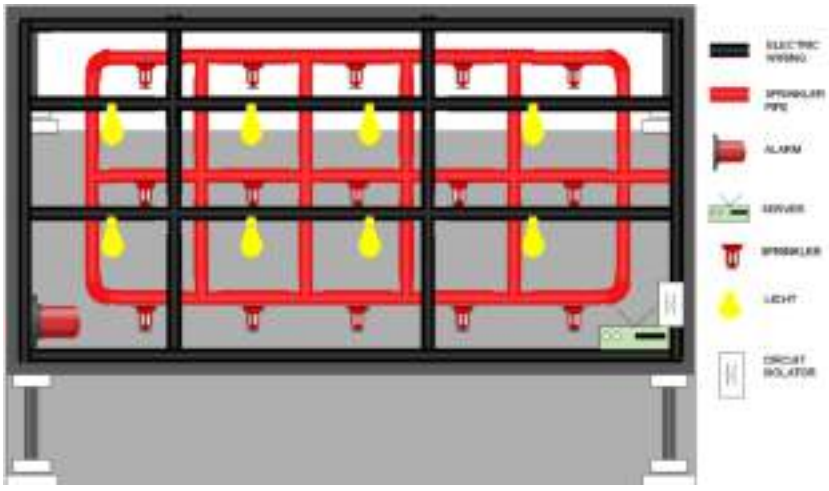
2. RESULT AND INTERPRETATION

The Wrist Band of Industrial Threat Protection System is classified into 3 switches according to different situation. These are briefly mentioned below:

Switch 1 (Alert): If the worker faces any trouble where he wants to alert the safety officer, then he will operate switch 1 of the safety wristlet. As soon as the switch is pressed an alert will be transmitted to the administration office where a safety in charge who is monitoring the activities will be displayed with worker's identity, situation & location concurrently safety wristlet will operate siren of that zone.

Switch 2 (Electrical Hazard): There are certain times when worker faces any electrical shock where there's a need of instant cut-off of power supply. In such a scenario, the worker will simply press switch 2. In response, the power will be cut-off instantly within 0.5 to 1 second. It is to be noted that the power cut-off of a particular zone won't affect the working of other zones.

Switch 3 (Fire hazard): If any hazardous situation related to fire occurs, the worker needs to press Switch 3. As soon as this switch is encountered, a signal is transmitted to the safety officer. The supervisor will respond within 10 seconds as to whether the sprinkler system should be activated or not (in case of non-hazardous fire).



The diagram shows a zone of an industry which consists of an installation of sprinkler system which is denoted by red pipes and sprinkler heads are installed at particular distances. The vertical and horizontal black pipes denote the electrical installation and yellow bulbs are installed for lightings.

3.CONCLUSION AND FUTURE SCOPE

It is a low budget & less power consuming personal protective equipment. Its installation in whole industry will lead to increase the safety & protection by a great extent. The advantages of same are:

a. It provides a safety of workers, employees as well as the plant, factories, industries, etc.
b. It is very effective in detecting the humans.
c. Low cost with great efficiency.
d. It helps in detecting humans at the time of fire hazard.
e. It doesn't having any bulky installation.
f. It provide wealth safety of organization also.
g. The system is very fast in response which makes easy to save workers and humans at the time of threat.
h. It can cut-off the power supply of whole 100m area in just 1.5 sec.
i. Sprinkler system can also be operated by it.
j. Worker can alert the administrative in case of emergency.
k. Report of system's action is saved by file can be accessible through mobile also from anywhere any time within industry range.

3. REFERENCES

1. US4567563A *1980-12-301986-01-28Energy Management CorporationIrrigation control system
2. US4583399A *1985-03-151986-04-22Walsh John EPrecipitation gauge
3. US4613764A *1984-09-191986-09-23Clemar Manufacturing Corp.Rain detector for irrigation control system
4. US5125458A *1991-01-281992-06-30Berman Steve AFire fighting apparatus

5. US5208855A *1991-09-201993-05-04Marian Michael BMethod and apparatus for irrigation control using evapotranspiration

6. US5218866A *1991-02-191993-06-15The United States Of America As Represented By The Secretary Of The ArmyMethod and device for measuring fluid velocities

7. US5311769A *1992-03-041994-05-17Hetzel Henry TMethod and apparatus for automatic measurement of evapotranspiration

8. US5465904A *1993-12-031995-11-14Vaello; Donald B.Domestic watering and agricultural irrigation control system

9. US5696671A *1994-02-171997-12-09Waterlink Systems, Inc.Evapotranspiration forecasting irrigation control system

10. US5803365A *1996-08-061998-09-08Ruttenberg; GideonFloating rotating sprinklers

11. US5839660A *1997-06-111998-11-24Morgenstern; PaulAuxiliary sprinkler system controller to maintain healthy turf with minimum water usage

12. US5870302A *1994-02-171999-02-09Waterlink Systems, Inc.Evapotranspiration remote irrigation control system

"Design Of Water Spray System For Flammable Liquid Tank In Oil & Gas Industry"

1.Abhay Raj, 2. Abhishek Gupta, 3. Arpit Agrawal, 4. Ashutosh Soni, 5. Ayush Gupta, 6. Kuldeep Singh Rajput, 7. Rahul Kumar

Veerendra Suryavanshi

B.E.(Fire Tech. and Safety Engg.) Scholar & Professor

IPS academy, Institute of engineering and science

Department of Fire Technology & Safety Engineering

ABSTRACT:

Although large-scale tank fires are very rare, they present a huge challenge to fire fighters, oil companies and the environment. There are only two alternatives for combating such a fire either to let it burn out and thereby self-extinguish or, alternatively, to actively extinguish the fire. One of the fire extinguish system used for fire extinguishing or to provide cooling effect, Water spray System are efficiently used on Storage tanks and hydrocarbon processing pumps. The discussion in this report is on the design of water spray system used for providing protection to tanks and pumps. The report also discuss about the rules, criteria used for designing the water spray system in RIL, DMD for different types of tanks and pumps being used in the complex. he report also discuss about the ITM philosophy used in the Reliance complex for the Water Spray System Overall the project report is all about the design of water spray system their advantage and the other system used in the spray system and its ITM philosophy.

Keywords: Water spray system, Blow off Cap, Flammable liquid tank, Oil & Gas processing plants.

1. INTRODUCTION

Water Spray -'Water Spray' refers to the use of water in a form having a pre-determined pattern, particle size, velocity and density discharged from specifically designed nozzles or devices.

Water Spray System - A special fixed pipe system connected to a reliable source of fire protection water supply and equipped with water spray nozzles for specific water discharge and distribution over the surface or area to be protected. The piping system is connected to the water supply through an automatically actuated deluge valve which initiates flow of water. Automatic actuation is achieved by operation of automatic detecting equipment installed along with water spray nozzles. There are two types of systems namely high velocity and medium velocity systems.

Water Spray System are considered effective for any one or a combination of the following:-

1. Extinguishment – Water spray extinguishes a fire by cooling, smothering, emulsifying.
2. Control of burning – With its consequent limitations of fire spread.
3. Exposure protection – Exposures are protected by applying water spray directly to the exposed structure.
4. Prevention of fire

Types of Water Spray System:-

1. Medium Velocity Water Spray System
2. High Velocity Water Spray System.

Applications of MVWSS:-MVWSS are to be installed for the following applications:-

1. For fire-risks involving the lighter oils, Liquefied Petroleum gases, and other flammable liquids, where it may not be possible or desirable to extinguish the fire completely.
2. For the protection of vessels, plant, and structures exposed to heat from adjacent and surrounding fires.
3. For use in conjunction with Sprinklers.
4. Cable galley and cable spreader
5. Switch yard and control room building.

Applications of HVWSS:-

1. Transformers, oil filled equipment's of power stations.
2. Turbo-alternators
3. Oil fired boiler room, oil quenching tanks.
4. Cable vaults.

2. LITERATURE REVIEW

Niall Ramsden et al. (2017) provides a research paper on A study of water cooling using different water application techniques to protect storage tank walls against thermal radiation. This paper shows that Amongst the hazards associated with storage tanks is the effect of the thermal radiation that results from an adjacent tank fire and its consequences for the mechanical strength of the metal and the tank contents at elevated temperatures, which may lead ultimately to the failure of the tank. A series of tests were undertaken to study the generation of dry spots and the effectiveness of the use of water cooling in reducing the hazards of fire for adjacent tanks. The research involved an extensive programme of experiments studying the effectiveness of different water cooling techniques on mitigating tank and pool fires. The work was conducted at Asturias, Spain, by the LASTFIRE Project. This report gives a description and the findings of the work performed, which involved evaluating the effectiveness of water cooling in reducing the heat loading on an adjacent tank impacted by a pool fire. The results demonstrate that water cooling and the liquid in the adjacent tank can significantly reduce heat loading, as the wall temperature is maintained below that at which catastrophic failure might occur, or such that the rate of temperature rise is reduced to a level that provides time for emergency response teams to control the fire incident.

3. PROBLEM FORMULATION

Legal Parameter

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India. The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

i) IS 15325

ii) NFPA 15

Statement of problem for which project is proposed

The safety of flammable fuel tanks is a matter of serious concern. Fire hazards lead into serious consequences such as explosion, spillage, BLEVE etc. Protection devices are not always accurate and fast due to possible malfunctions or other technical matters so the need for multiple devices and functions is required as backup. The installation of spray system is a reliable method of preventing and extinguishing fires on tanks containing flammable liquids for early detection and controlled burning in comparison with an older equipment. Present Research Work under Project Title.

Today's times, the designing of piping systems has become an important field. With increased urbanization, and construction of complex infrastructures like advanced warehouses, factories, power distribution centers, refineries, multi-storied residential and commercial buildings, etc. , having a good piping system is a must for supplying adequate amount of clean water for fighting against fire threats. Earlier, piping design was done by using many manual calculations and formulation methods. This made piping design a laborious and time-consuming process and it was also prone to large amount of errors. However, modern piping design is done by using software such as ANSYS, CFD, AUTOCAD, etc. for doing calculations and drawing/designing the required layout. This not only reduces the computation times, but also allows us to have a virtual simulation of the chosen design, thereby giving us a better idea about how effective the chosen piping design will be before it is implemented, thus allowing us to fine tune the design for better output and also reducing the errors. In this paper, we highlight the requirements of a good piping system, and we elaborate upon the various steps involved in designing of such systems, and choosing the suitable type of piping layout for the required conditions such as available pressure, consumption demand, flow rate, etc. and performing various calculations on the basis of the above factors.

4. AREA OF STUDY

We are taking oil and gas processing plant as an occupancy/industry.

Oil and gas processing plant: Oil and gas wells produce a mixture of hydrocarbon gas, condensate or oil; water with dissolved minerals, usually including a large amount of salt; other gases, including nitrogen, carbon dioxide (CO2), and possibly hydrogen sulphide (H2S); and solids, including sand from the reservoir, dirt, scale, and corrosion products from the tubing. The purpose of oil and gas processing is to separate, remove, or transform these various components to make the hydrocarbons ready for sale.

Different spray systems are applied in the hydrocarbon refineries to protect process units, storage tanks , transformers , cable vaunts etc in case of fire.

So different area of study are :-

Medium Velocity Water Spray System (MVWSS):-

Generally applied on storage tanks, storage and control room etc. MVWSS are designed for directional spray application in fixed fire protection system which consists of a network of open spray nozzles fitted with an external deflector, which discharges water in a directional cone shaped pattern of small droplet size. The water is uniformly distributed over the surface to be protected. Water is applied through sprayers.

The Nozzles are effectively designed to apply water to exposed vertical, horizontal, curved and irregular shaped surfaces to allow cooling to prevent excessive absorption of heat from external fire and avoid structural damage or spread of fire. In some application nozzles may be installed to control or extinguish the fire depending on water design density as per applicable codes. The nozzle is used in deluge water spray system for special hazard fire protection application.

High Velocity Water Spray System (HVWSS):-HVWSS are designed for use in fixed water spray or deluge system for the fire protection application on transformers, terbo enginea cable vaunts etc. HVWS nozzles are internal swirl plate type open nozzles. These nozzles produce solid uniform and dense core of high velocity water spray to effect fire control. Water is applied through projectors, discharging a cone of water in the form of evenly distributed

broken streams of high velocity and high momentum. The minimum desirable pressure to achieve a reasonable spray pattern is 3.5 bars and maximum desirable pressure is 5 bars.

5. MATERIAL AND METHODOLOGY

Blow off cap

It is an outer cover for nozzle having a closed end portion and wall portion that together form an open ended cavity shaped to receive the discharge end of the nozzle and cover the orifice the closed end portion includes a closed end that is located in close proximity to the orifice of the nozzle when the blow off cap is mounted on the discharge end of the nozzle such that the orifice direct the fire water spray directly onto the closed end portion.

The blow off cap wherein the O-ring provides a seal to prevent grease from entering the nozzle.

The blow off cap the interior groove having a depth and height based on at least one of an o-ring size and a discharge pressure the blow off cap cover is formed of metal or plastic.

Divide water sprayer ring into segment:-

We can divide water sprayer ring into three segments to maintain 1LPM/M2 discharge of spray outlet at tank present outside of (R+30) M of the fire tank

Also solve problem of water wastage during cooling of storage tank which is outside of (R+30)M from centre of fire tank.

6.RESULT AND INTERPRETATION

We Take Vertical Storage Tank, Class B fuel

H= 19.025 m

D= 20.012 m

Total Surface Area To Be Covered= $2\pi rh$

= 2*3.14*10.006*19.025

= 1196.09 m^2

Total Water Required For Cooling= total surface area *water flow rate required for cooling(lpm/m^2)

= 1196.09* 10.2

= 12200.11 LPM

= 732.01 M^3/HR

Ring Calculation,

H=19.025 M,

According To TAC The Bottom Ring Should Always Be 2m Above The Bottom Of The Tank,

So, No. Of Rings,

= 17.025/3.5

= 5

Total No. Of Ring ,

= 5+1

=6

We Consider, Sprayer Angle = 120

So No. Of Sprayers,

= π(20.023+1.2)/1.9

= 35.09

= 36

Nozzle Discharge,

= 12200/ (36*6)

= 56.48 LPM

Now For K Factor,

K= $Q/P^{1/2}$

= 57/1.414

= 39.93

= 41

7. CONCLUSION

Water spray systems should only be designed by specialists. All system designs should include working drawings, specifications and hydraulic calculations which should be forwarded to the manufacturer of the installation components for approval.

Consideration should be given to drainage facilities to handle water discharged from the system and to the likelihood of spilt combustible or flammable liquids which may be present within the protected area.

The discussion in this report show the design criteria selected for water spray system selection for tanks it also show the installation philosophy carried out refinery and petrochemical plant according to OISD, TACAND NFPA standards to ensure the water spray system should be in good working condition.

8. REFERENCES

i. Zhaowen Wang et al."Effects of water content on evaporation and combustion characteristics of water emulsified diesel spray" Volume 226, 15 September 2018, Pages 397-407

ii. HongLiu et al "Experimental investigation on heat transfer of spray cooling with the mixture of ethanol and water" Volume 133, November 2018, Pages 62-68

iii. Lzhou et al. "Experimental investigation on the performance of a water spray cooling system" Volume 112, 5 February 2017, Pages 1117-1128

iv. W.Plumecocq et al. " Numerical method for determining water droplets size distributions of spray nozzles using a two-zone model" Volume 324, 1 December 2017, Pages 67-77

v. HiroakiWatanabe et al. " Numerical investigation on propagation behavior of gaseous detonation in water spray" pp.1-10,2018

vi. Rules for Water Spray Systems - TAC (Tariff Advisory Committee)

vii. IS 15325: Design and Installation of Fixed Automatic High and Medium Velocity Water Spray System

viii. NFPA – 15: Standard for Water Spray Fixed Systems for Fire Protection.

ix. OISD 116: Fire Protection Facilities for Petroleum Refineries & OIL/GAS Processing Plants.

"Evaluation of water requirements for fire sprinklers in Residential buildings"

1. Dharmendra Nagar, 2. Kapil Patidar, Arun Rathore, 3. Deepak kumar Sad, 4. Abhishek

Department of Fire Technology & Safety Engineering, IPS Academy Institute of Engineering & Science, Indore

ABSTRACT

Automatic fire sprinkler systems are effective in saving lives in residential occupancies. Consequently, model building codes have recently included provisions requiring residential fire sprinklers in all newly constructed one- and two-family homes. However, factors related to water supplies are considered by state and local jurisdictions in making decisions on the adoption of such model codes and their residential fire sprinkler requirements. In addition to saving lives, there are unrecognized benefits in protecting homes with residential fire sprinklers, such as the conservation of water and the potential reduction of water infrastructure demands in communities. Water usage by fire services is expected to be significantly less for homes protected by a fire sprinkler system. Another consideration by state and local jurisdictions is that conventional water meters for combined service (i.e. domestic potable and fire sprinkler system service) are perceived to be unsuitable for residential fire sprinkler systems based on pressure loss characteristics, flow capacity limitations, and reliability characteristics. To address these factors, the research team performed the following tasks:

i) a study of water consumption during fire events and the resulting impact of sprinklers on the water infrastructure demand for detached one- and two-family home communities, and

ii) an evaluation of the performance of water meters when used to supply residential fire sprinkler system.

1. INTRODUCTION

Sprinkler: - A Fire suppression or control device that operates automatically when its heat activated element is heated to its thermal rating or above, allowing water to discharge over a specified area.

Sprinkler system: - An integrated system of underground and overhead piping designed in accordance with good fire engineering practice. The system includes a dedicated water supply that caters to one or more systems. The portion of the system above ground is a network of specially sized or hydraulically designed piping installed in a building to which sprinklers are attached in a systematic pattern. Each system has a control valve that includes a device for actuating an alarm when the system is in operation. The system is actuated by heat from a fire and discharges water over the fire area.

All sprinkler heads have:

i. A thermal sensing element that responds to heat.
ii. An orifice through which water is released under pressure.
iii. A deflector that forms a spray pattern of water over the fire.

Types of Sprinkler Systems:-

i. Wet pipe systems
ii. Dry pipe systems
iii. Pre-action system
iv. Deluge system

2. AREA OF STUDY:-

System Domain :- A dwelling is a unit of residential accommodation occupied by a single person or by people living together as a family or by not more than six residents living together as a single household, including a household where care is provided for residents.

According to the English Housing Survey Housing Stock Report, 2014-15, prepared by the Department of Communities and Local Government, dwellings are classified into the following categories:-

i. Small terraced house
ii. Medium/large terraced house
iii. End terraced house
iv. Mid terraced house
v. Semi-detached house
vi. Detached house
vii. Bungalow
viii. Converted flat

Area of chance of occurrence of fire:-

Electric blanket	Hair styling tools	Cluttered cupboards
Candles	Household wiring	Electrical products
Glassware	Fairy lights	Kitchen

3. PROBLEM FORMULATION: - The purpose of this formulation shall be to provide a reasonable degree of protection for life and property from fire through standardization of design, installation, and testing requirements for sprinkler systems, including private fire service mains, based on sound engineering principles, test data, and field experience.

Sprinkler systems and private fire service mains are specialized fire protection systems and shall require knowledgeable and experienced design and installation.

This standard shall apply to:

i. Character and adequacy of water supplies
ii. Selection of sprinklers
iii. Fittings
iv. Piping
v. Valves
vi. All materials and accessories, including the installation of private fire service mains

This standard shall also apply to "combined service mains" used to carry water for both fire service and other uses as well as mains for fire service use only.

As it is difficult to quantify sprinkler performance in real fires in terms of heat release rate, a number of other criteria have been used, such as:

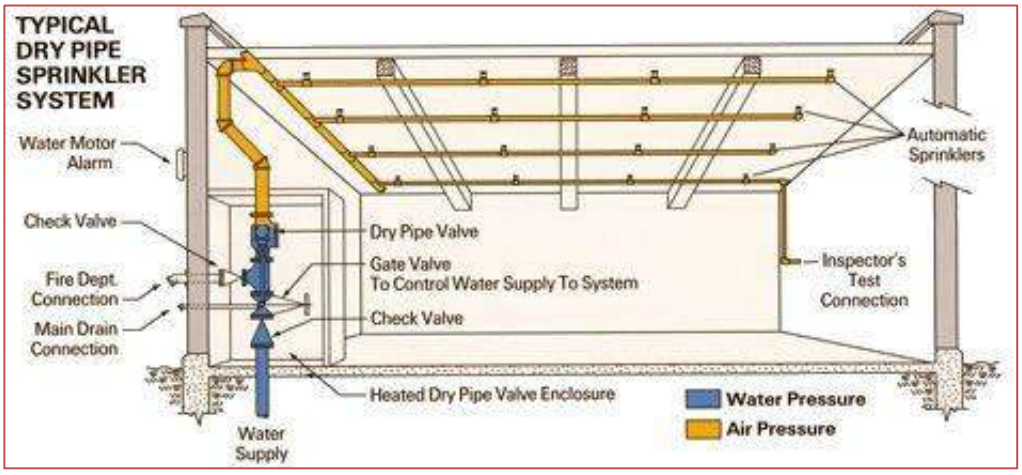
i. Fire containment to room of origin
ii. Number of sprinklers activated
iii. Amount of damage to structure and property
iv. Required amount of fire service intervention
v. Occupant injuries or fatalities

4. ANALYSIS & METHODOLOGY:-

The Residential Sprinkler Design Process:-The residential fire sprinkler design process can vary from projects like a single small dwelling to a high rise building. We will normally require room layouts which incorporate a reflected ceiling plan. The reflected ceiling plan is particularly important if we are required to line fire sprinkler heads with ceiling fixtures like down lights, air recycling and heat recovery units, ceiling mounted loudspeakers and smoke detectors etc.

Sprinkler heads are positioned as symmetrically as possible while ensuring they are within their design parameters to complete the design process. After completing the design, we will then calculate the losses within the pipe work using a sprinkler design software package and produce a full specification for the system.

Sprinkler Layout:-



Water Supply Options: - A standard domestic water supply is around 30 liters per minute delivered through a 25mm connection. At a flow rate of 30 liters per minute, the hydraulic losses are minimal assuming that the main water supply is situated relatively close to the

property boundary and the length of feed within the boundary are not excessive. A fire sprinkler system however, is designed to deliver more than 3 times this quantity of water. At these flow rates, hydraulic losses increase exponentially rendering a 25mm feed impractical.

If the supply is to be used for a combined domestic and fire sprinkler system, theoretically the answer is yes. However, this configuration does pose a problem because water companies are unlikely to provide an unmetered domestic supply. A standard domestic rated water meter will not pass the quantity of water needed for a domestic sprinkler system without introducing excessive hydraulic losses.

We have a new 32mm supply. There is 2.2 bar pressure in the mains but the fire sprinkler pressure requirement is 2.4 bar. Pumps can be utilized directly on a new mains water supply subject to Water Board consent however, the pump will only increase the pressure. It will not increase the flow rate.

5. SOLUTION DOMAIN:-

Water is the most commonly used fire extinguishing agent, mainly due to the fact that it is widely available and inexpensive. It also has very desirable fire extinguishing characteristics such as a high specific heat and high latent heat of vaporization. A single gallon of water can absorb 2586.5 kJ of heat as it increases from a 70^0 F (21^0C) room temperature to become steam at 212^0 F (100^0C).

Water is not the perfect extinguishing agent, however, and is considered inappropriate for the protection of certain water reactive materials. In some cases, the use of water can produce heat, flammable or toxic gases, or explosions. The quantities of such products must be considered, however, because application of sufficient water can overcome the reaction of minor amounts of these materials. Another drawback of water is that it is more dense than most hydrocarbon fuels, and immiscible as well. Therefore, water will not provide an effective cover for burning hydrocarbons, or mix with them and dilute them to the point of not sustaining combustion. Instead, the hydrocarbons will float on top of the water, continuing to burn and possibly

spread. To combat such fires, foam solutions can be introduced into the water to provide an effective cover and smother the fire. Applying water in a fine mist has also been successful. However, even when water from sprinklers will not suppress the fire, its cooling ability can protect structural elements of a building by containing the fire until it can be extinguished by other means.

Let us consider building of dimensions 60′ X 30′

Total floor area = 60′ X 30′

For main floor

= 1800 sq. feet

= 167 m^2

Total no. of floors = 3

Total floor area of whole = 167 * 3 m^2

Building

=501 m^2

Floor area where sprinklers are not installed

(i.e. Garage area in Basement) = 16′ X 18′

= 288 sq. Feet

= 27 m^2

Total floor area where sprinklers are not installed = 27 m^2

So, total floor area where sprinklers are not installed = 501 m^2 – 27 m^2

= 474 m^2

Building contains large amount of flammable material as:

Table: 6.1 Description of Material inside the building

S.No.	Material	Calorific value (kJ/kg)	Mass(kg)
1.	Wood	3441	755
2.	PVC material	9797	200
3.	Paper material	3226	50
4.	Textile materials	1700	225

$F_l = M_c * C / A$

Fire load = (3441*755) + (9797*200) + (3226*50) + (1700*225)/501

= 5101155/501 kJ/m^2

=10182 kJ/m^2

Coverage area per sprinkler head = total floor area / no. of heads

= 474 m^2 / 43

= 11.023 m^2

Rate of flow (Q) = coverage area * density

= 11.023* 10.22 /11

= 10.22 lpm

Pressure (P) = $(Q/K)^2$

= $(10.22/5.6)^2$

= 3.33 psi

Where,

Q= Flow of water

K= k-factor (is 5.6 for sprinklers in residential building According to NFPA 13)

Pressure loss due to friction

$p = 4.52Q^{1.85} / C^{1.85}d^{4.87}$

where p = friction loss per ft of pipe in psi

Q = flow rate in gpm

d = internal pipe diameter in inches

C = Hazen-Williams coefficient

$p = 4.52(2.641)^{1.85} / (100)^{1.85} (1.25)^{4.87}$ (C= 100 for cast iron pipe)

= (4.52*6.02) / (5011.8*2.96)

= 27.21/14857.49

= 0.001831 psi

Net pressure at head= total stream pressure - pressure loss due to friction

= 3.33 – 0.001831

= 3.32 psi

So, Net pressure at the head = 3.32 psi

Fire water calculations

Total no. of sprinkler heads in whole building = 43

Discharge per head (as per NFPA 13D) = 10.22 lpm

Minimum operating time = 15 minutes

Minimum amount of water required = No. of sprinkler heads * per head discharge * T_o

Minimum amount of water required = 43 * 10.22 * 15

= 6591 liters

So, Total fire sprinkler water required including safety factor = 7000 liters.

So, Total fire sprinkler water required including safety factor = 7000 liters

6. APPLICATION DOMAIN:-

Benefits of Fire Sprinklers:-

i. Reduce The Risk Of Death
ii. Cost Effective Fire Protection System
iii. Save lives
iv. Reduces The Risk Of Damage To Your Property
v. Minimal Maintenance
vi. Reduced Insurance Costs
vii. Increase The Value Of Your Property

7. EXPECTED OUTCOME & CONCLUSIONS:-

Evaluated water requirement: - We have considered the residential 2 story building with basement and the active fire protection system i.e. fire sprinkler system which is installed throughout the building after calculating the fire load of whole building including (wood, paper& PVC) is 10182 kj/kg and the total floor area is 501 m^2.

The sprinkler system is operated for 15 minutes if the fire occurred the,

We evaluated the minimum water storage = 7000 liters

Myths and Facts about Sprinkler Systems:-

Automatic sprinkler systems have sustained an enviable record of protecting life and property for over 100 years. Yet, there are still common misunderstandings about the operation and effectiveness of automatic fire sprinkler systems

Myth:-"Water damage from a sprinkler system will be more extensive than fire damage."

Fact: - Water damage from a building sprinkler system will be much less severe than the damage caused by water from firefighting hose lines or smoke and fire damage if the fire is allowed to spread. Quick response sprinklers release 8-24 gallons of water per minute compared to 80-125 gallons per minute discharged by a fire hose.

Myth:-"When a fire occurs, every sprinkler head goes off."

Fact:-Sprinkler heads are individually activated by fire temperatures in excess of 155°. Residential fires are usually controlled with one sprinkler head. 90% of all fires are controlled with six or fewer heads and a study conducted during 80 years of automatic sprinkler use found that 82% of the fires that have occurred were controlled by two or fewer sprinkler heads.

Myth:-A smoke detector provides enough protection."

Fact:-Smoke detectors save lives by providing an early warning to a smoke or fire incident, but can do nothing to extinguish a growing fire or protect those physically unable to escape on their own, such as the elderly or small children. Too often, battery operated smoke detectors fail to function because the batteries are dead or have been removed. As the percent of homes in America that were "protected" with smoke detectors increased from zero to more than 70%, the number of fire deaths in homes did not significantly decrease.

Myth:-Sprinklers are designed to protect property, but are not effective for life safety."

Fact:-Sprinklers provide a high level of life safety. Statistics reveal that there has never been any multiple loss of life in a fully sprinklered building. Property losses are 85% less in residences with fire sprinklers compared to those without sprinklers. The combination of automatic sprinklers and early warning systems in all buildings could reduce overall injuries, loss of life and property damage by at least 50%.

8.REFERENCES

1. Sprinkler Systems and Residential Structure Fires (October 2017)
2. Evaluation of Fire Protection Systems in Commercial High rise Buildings for Fire Safety Optimization A Case of Nairobi Central Business District (10, October2015)
3. Evaluation and Analysis of Hospital Disaster Preparedness in Jeddah (10November 2014)
4. A review of sprinkler system effectiveness studies(YEAR 2013)
5. Residential Fire Sprinklers – Water Usage and Water Meter Performance Study (February 2, 2010)

6. The Promotion and Research of Residential Sprinkler Systems A Safer Future with Residential Sprinklers (YEAR 2009)

7. Water Supply Systems and Evaluation Methods (October 2008)

8. 10 Design and operation of sprinkler systems(January 2007)

9. Simplified design and fabrication of water sprinkler system: a survey based analysis (YEAR 2003)

10. An analysis of domestic sprinkler system for US in new Zealand (August 1995)

11. NFPA 13 Standard for the Installation of Sprinkler Systems

12. NFPA 13R Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height

13. NFPA 13D Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

14. NFPA 13E Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems

15. IS 15105 Design and Installation of fixed automatic sprinkler fire extinguishing system--Code of practice

16. NFPA Fire protection Handbook twentieth edition

a) Section15- water supply for fixed fire protection

b) Section 16- water-based fire suppression equipment

"Risk Assessment of Horizontal Pressurized Chlorine Tonner in Thermal Power Plant"

1. Matte Pravin Mahadev, 2. Mohammad Laareb Khan, 3. Asad Khan, 4. Aman Tanwar, 5. Harish Patidar, 6. Harshit Jain, 7.Aachaman Sharma

Department of Fire Technology and Safety Engineering, IES, IPS Academy, Indore

Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

ABSTRACT

In the current industrial scenario there is a serious need for formulating strategies to handle hazardous substances in the safest way. This paper deals with the risk assessment of release of chlorine gas along with the precautionary measures and protection system. This paper assesses the maximum credible scenarios of chlorine leak from its containment, consequence effect zones is been evaluated using Area Location of Hazardous Atmosphere (ALOHA) software package and the enlarged form of this model diagram has been outlined on the area map of the study area. This project highlight some silent feature of the emergency scenario from a chemical plant, which ultimately lead to fatal consequences all around upon releases of toxic chlorine gas.

1. INTRODUCTION

Risk analysis can be defined in many different ways, and much of the definition depends on how risk analysis relates to other concepts. Risk analysis can be "broadly defined to include Risk assessment, risk characterization, risk communication, risk management, and policy relating to risk, in the context of risks of concern to individuals, to public- and private-sector organizations, and to society at a local, regional, national, or global level." A useful construct is to divide risk analysis into two components:

I. Risk assessment (identifying, evaluating, and measuring the probability and severity of risks)

II. Risk management (deciding what to do about risks)

Some books take a slightly different approach and define risk management as the overarching concept, where risk analysis is the component that seeks to identify and measure the risks and risk mitigation is determining what to do about the risks.

Risk analysis can be qualitative or quantitative. Quantitative Risk analysis uses words or colors to identify and evaluate risks or presents a written description of the risk, and Quantitative Risk analysis (QRA) calculates numerical probabilities over the possible consequences

QRA seeks to numerically assess probabilities for the potential consequences of risk, and is often called probabilistic risk analysis or Probabilistic Risk Assessment (PRA). The analysis often seeks to describe the consequences in numerical units such as dollars, time, or lives lost. PRA often seeks to answer three questions:

What can happen? (i.e., what can go wrong?)

How likely is it that it will happen?

If it does happen, what are the consequences?

Thus, risk R can be described as a set of triplets, R={<si,pi,ci>}, i=1,2,...,N where si is scenario i, pi is the probability of scenario i, ci are the consequences if scenario i occurs, and Nis the total number of scenarios. This type of analysis typically results in a Probability distribution over the consequences.

2. LITERATURE REVIEW

I. Journal of Loss Prevention in the process Industry (Toxic release of chlorine & off-site emergency scenario - A case study) ; Biswajit Ruj, Pradeep Kumar Chatterjee :-In this paper, they consider all the possible identification with regards to hazard of chlorine gas & the maximum credible loss scenario have been assessed by applying Complex Hazardous Air Release Model (CHARM) software package.

II. Accidental Release of chlorine from a storage facility & an On-site emergency mock drill: A case study; Ambalathumpara Raman Soman & Gopalswamy Sundararaj: -This paper deals with an Onsite emergency response in a chlorine manufacturing industry. It was developed on the basis of the previous study on chlorine release & risk zone has also been estimated with reference to a chlorine exposure threshold of 3ppm.

III. Journal of pharmacy & bio allied sciences; Chlorine leak on Mumbai port trust's Sewri yard – A case study; Rakesh Kumar Sharma, Raman Chawla& Surendra Kumar :-This paper includes a complete case study of chlorine leak on 14 July 2010 at the Haji Bunder hazardous cargo ware house in Mumbai Port trust, Sewri.

IV. Theory & objectives of Air Dispersion Modelling; Robert Macdonald: -The focus of this review is on the near field impact (<10-20 km) of industrial sources. The model is to be able to predict rates of diffusion based on measurable metrological variables such as wind speed, atmospheric turbulence & thermodynamic effects.

3. PROBLEM FORMULATION

Need For Risk Analysis

Inherent dangers of Chlorine

Toxic by inhalation.

Very toxic to the aquatic life.

Highly Corrosive in moist conditions Strong Oxidizer

Health effects: Chlorine is irritating to nose, throat, skin and eyes also tearing, coughing and chest pain. Higher levels burn the lungs and can cause a buildup of fluid in the lungs (pulmonary edema) and death. Contact can severely burn the eyes and skin. Repeated exposures or a single high exposure may permanently damage the lungs. It can also damage the teeth and causes a skin rash.

Environmental effects: Chlorine is classified as dangerous for environmental as specified in Directive 67/548/EEC, Annex I. Degradation in air and water is mediated by exposure to UV components of sunlight, with daytime half lives generally < 6 hours. Chlorine hydrolyzes very rapidly in water. In fresh and waste water at pH > 6, complete hydrolysis occurs with the formation of hypochlorous acid and chloride ion. Chlorine may react with soil components to form chlorides.

Depending on their water solubility these chlorides are easily washed out from the soil. Free chlorine reacts rapidly with in organics such as bromide and more slowly, with organic material present in natural water. These reactions yield chlorides, oxidized organics,

chlororganics (including trihalomethanes), oxygen, nitrogen, chlorates, bromates and bromorganics. There is no potential for the bioaccumulation or bio concentration of chlorine.

Emergency Overview: Chlorine is a greenish yellow gas (or amber liquid) with an irritating odor. High concentration of chlorine gas may cause an oxygen–deficit atmosphere. Chlorine is an oxidizer, which can act to initiate and sustain the combustion of flammable materials. Chlorine is heavier than air and pockets of this gas can accumulate in low-lying areas.

Inhalation: Toxic and irritating. Exposure to chlorine gas may cause severe irritation of mucous membranes of the nose, throat and respiratory tract followed by severe coughing, burning, chest pain, vomiting, headache, anxiety and feeling of suffocation. Remove victim(s) to fresh air, as quickly as possible. If breathing was stopped, trained personnel should administer supplemental oxygen and/or artificial respiration. Keep the affected person warm at rest. In mild cases, give milk to relieve throat irritation. Get medical attention as soon as possible.

4.AREA OF STUDY

About 4000MW Sasan Ultra Mega Power Project:

Sasan Power Ltd is executing 3960 MW Sasan Ultra Mega Power Project (UMPP) through at Sasan village, District Singrauli, Madhya Pradesh. Sasan UMPP has been allotted 3 captive coal mines which makes it biggest integrated coal mine cum power project in India Sasan UMPP is a project of national importance and would benefit 3 crore people in 7 states of India. State of Madhya Pradesh is the largest beneficiary with 1,485 MW (37.5% of total capacity) allocated to the state.

The EPC Contract for the Project is in place between Sasan Power Limited (Subsidiary of Reliance Power Limited) and Reliance Infrastructure Limited (LOI SUMPP/CPG-14234/AGMNT). Reliance Infrastructure Limited has appointed internationally reputed consultants such as Black & Veatch, Toshiba Power Systems (TPSC), Development Consultants private Limited (DCPL),STUP and HOK etc. for design and development of the project.

The proposed Chlorination plant is located adjacent to the cooling tower units. In the north side of the plant there is a center passage of the plant and a switch yard control room to the North West side of the plant.

The operational activities for normal operations as well as emergency services for the Chlorination plant will be integrated within the existing plant management system.

5. MATERIAL AND METHODOLOGIES

A. Materials of Construction

In the selection process for the materials to be used, the designer must consider the operating parameters in which the scrubbing system will be expected to perform not only under normal process conditions but also during upsets. Different concentrations and temperatures of hypochlorite and sodium hydroxide can affect the corrosiveness of these solutions. Therefore, the particular normal and upset operating conditions will impact the selection of the appropriate materials of construction. Each installation must be studied individually to obtain a safe, economic and efficient system. The use of improper materials can lead to premature failure of system components. Titanium is an excellent material of construction for scrubbing system components as long as it is only exposed to wet chlorine.

It can spontaneously ignite when exposed to dry chlorine. Details of materials commonly used in scrubbing systems are:

Definition of Materials ABS	Acrylonitrile butadiene styrene
Carbon Steel	A ferrous material compatible with dry chlorine piping, typically used for piping
CPVC	Chlorinated polyvinyl chloride
ECTFE	Ethylene chlorotrifluoroethylene
EPR	Ethylene propylene rubber
FEP	Fluorinated ethylene propylene
FRP	A reinforced plastic material made of glass fiber, with a suitable resin to withstand the corrosive environment of the application
PE	Polyethylene

PFA	Perfluoroalkoxy
PPL	Polypropylene
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl chloride
PVDF	Polyvinylidene fluoride

6. RESULT AND INTERPRETATION

The chlorine release was an extremely serious accident that could have had severe consequences under less favorable circumstances. It is clear that the residents at the neighboring areas seems to lack information regarding the potential hazards related to the activity in the plant, warning procedures in case of emergency and the actions that they should take in that event. The results are as follows- Risk identified as per the Chlorine storage facilities. Design of Chlorine leak absorption system is prepared on the basis of identified risk. Formulation of Emergency plan on the basis of available hazard.

7. CONCLUSION, RECOMMENDATION AND FUTURE SCOPE

A. Conclusion

At the end of this research we can conclude that, to mitigate the emergency arise from the hazardous chemical like chlorine; it is very essential to improve the safety systems we are following in industry. The requirements mentioned in the acts and laws are the minimum. As the hazardous chemical accidents are still happening we need to go ahead the rules and regulations to achieve the target of "Zero Accidents".

B. Recommendation

Many industries are using the chlorine leakage kit type B having tie- rods, which needs to set first to arrest the leakage. Emergency crew has to attach tie rods with chlorine tonner. From the experience it is learned that attaching the tie roads with horizontal bar is time consuming task. To make it more simple, tie rods can be pre-attached using chain, which ultimately reduces the exposure time.

The process shall be designed to collect all sources of gas containing chlorine (continuous and intermittent flows). These may arise from a variety of origins and can be made up by:

I. Venting of vessels or equipment containing chlorine contaminated liquids (brine, chlorine pipe condensates etc.).

II. Venting of chlorine on-line analyzers.

III. Tail gas from chlorine liquefaction unit.

IV. Vent gas arising from start-up and shutdown of electrolytic plant.

V. Emergency depressurization of chlorine systems.

C. Future Scope

Safety absorption units will be designed to handle chlorine gas, usually close to atmospheric pressures, and not liquid. Where some liquid chlorine can be present in the vent (e.g. relief devices), a knock out drum fitted with suitable means of detecting liquid (temperature, level) should be installed in the line to trap any liquid chlorine before it can reach the absorption unit. This chlorine can then be allowed to vaporize to the absorption unit at an acceptable rate.

8. REFERENCES

1. Biswajit Ruj, Pradeep Kumar Chatterjee, "Toxic release of chlorine & off-site emergency scenario - A case study", Journal of Loss Prevention in the process Industry, 2010, Vol-25, pp. 650-653.

2. Ambalathumpara Raman Soman & Gopalswamy Sundarara, "Accidental Release of chlorine from a storage facility and on-site emergency mock drill: A case study", The scientific world Journal, 2009, Vol-2015, pp. 11-12.

3. Nirav G Joshi, Dr. Nihal A Siddiqui, „Study and Recommendations for Safe Handling of Chlorine in Industry", Journal of chemical education, 2009, pp. 10-27.

4. ZHAO Peia, LIU Zudeb, "Impacts of wind speed and leakage height on chlorine leakage diffusion", Procedia Engineering, 2009, Vol-84, pp. 622-681.

5. R. K. Gangopadhyay, S. K. Das and M. Mukherjee, "Chlorine leakage from bonnet of a valve in a bullet – a case study", Journal of loss prevention in process industries, 2009, Vol-18, pp. 11-12.

6. Salim, "Water Treatment Process using automatic dosage control", International Journal of advanced Technology an Engineering Explanation, 2009, Vol-4, pp. 39-98.

7. Perry R.H. & Green D.W. (2008) Chemical Engineers‟ Handbook, 6th (1984), McGraw-Hill.

8. Perry R.H. & Green D.W., Chemical Engineers‟ Handbook, 7th (1997), McGraw-Hill.

9. J.H. Saleh, K.B.Marais, E.Bakolas and R.V. Cowlagi, (2014) "Highlights from the literature on accident causation and system safety: Review of major ideas, recent contributions, and challenges", *Reliability Engineering and System Safety*, vol. 95, PP. 1105–1116.

10. Vivek V. Khanzode, J. Maiti, and P K Ray, (2013) "A Methodology for evaluation and monitoring of recurring hazards in under coal mining," *Safety Science*, vol. 49, PP. 1172-1179.

11. Blaine Reeder and Anne M Turner,(2012) "Scenario- based design: A method for connecting information system design with public health operations and emergency management," *Journal ofBiomedical informatics*, vol.44, PP. 978-988.

12. P.K. Marhavilas, D. Koulouriotis and V. Gemeni, (2012) "Risk analysis and assessment methodologies in the work sites: On a review, classification and comparative study of the scientific literature of the period 2000-2009," *Journal of Loss Prevention in Process Industries*, vol. 24, PP. 477-523.

13. Hualin Liao, Zhichuan Guan and Gang Long (2011) "International Conference on Future Electrical Power and Energy Systems Quantitative Risk Assessment on Safety and Reliability of Casing Strength for Oil and Gas Wells," *Energy Procedia*, vol. 17, PP. 429 – 435.

14. EhabZalok and James Eduful, (2010) "Assessment of fuel load survey methodologies and its impact on fire load data," *Fire Safety Journal*, vol. 3, PP. 1-12.

15. Linn Iren Vestly Bergh, SiriHinna, StavroulaLeka and Aditya Jain, (2010) "Developing a performance indicator for psychosocial risk in the oil and gas industry," *Safety Science*, vol. 62, PP. 98–106.

16. X. Seguí, R.M. Darbra, Juan A. Vílchez, and J. Arnaldos, (2010) "Methodology for the quantification of toxic dispersions originated in warehouse fires and its aPPlication to the QRA in Catalonia (Spain)," *Journal of Loss Prevention in Process Industries*, vol.32, PP. 404-414.

PLACEMENT DETAILS

Students Placed in 2015-19 Batch