

# FIRE AUDIT – A FORWARD LOOKING APPROACH

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## Abstract

*Fire in any occupancy has potential to cause harm to people and severe damages to property. Fire Safety audit is found to be the effective tool for assessing fire safety standards of an organization. It helps the people to identify the areas for improvement and evolve an action plan. In addition to technical risk control measures like fire prevention and fire protection the insurance protection against the property damage is also required. This paper presents an overview of the features and advantages of fire safety audits.*

## Preamble

Fire is one of the threats faced by every individual and organization. The accidental death statistics provided by National Crime Research Bureau, India reveals that about 19000 people per year lost their lives due to fire during the years 2003 & 2004. The state of Tamilnadu has been witnessing loss of lives in the range of 100 – 250 every year due to fires in the recent years (**Refer table 1**). Apart from human casualties, fires can cause property damage affecting the building, plant and machinery, furniture and fittings, electrical and electrical equipment etc. The loss of property to the tune of even Rs. 600 crores per year has been experienced recently by some of the insurance company in India. The details collected from few insurance companies are given in **table 2**. The above losses are coupled with business interruption losses which are not covered in many of the cases. The other losses like loss of market, loss of good will, loss of data, damage to the reputation can not be assessed quantitatively and hence pose severe threats to the survival of the organization. Interestingly many of the property losses are not covered by insurance due to lack of insurance awareness and cost factor involved in taking insurance in India. The total actual due to fires in the country could be of high magnitude.

## Need for Fire Safety audit

The National Building Code of India lays down a set of minimum provisions to which the buildings should be designed to protect the safety of the public. The regulations can be adopted immediately or enacted for use by various departments, municipal administrations and public bodies. Part IV of the code relates specifically to fire protection and Clause 9 to 'Requirements of Educational buildings' provides guidelines on fire-safe building designs. These guidelines become mandatory provisions once if state governments adopt the code through legislation. Many states like Tamilnadu, Karnataka etc. have passed fire service acts to ensure fire safety of buildings. Through this act the fire services are empowered to issue Fire License/ No Objection Certificate to building owners which will enable them to get clearance for occupation from Metropolitan Development Authority/ City Municipal Corporation etc. The fire license is issued based on the adherence to National Building Code provisions with respect to fire safety. In case of industrial buildings the requirements of factories rules, Oil Industry Safety Directorate guidelines should also be complied with additionally wherever applicable.

Despite the above mandatory requirement fires keep happening in less hazardous non-industrial type buildings also. The recent major fire in a shopping complex in Lucknow, UP has drawn the attention of the entire nation towards such incidents. Going down the memory lane one might recall that the fire in Kumbakonam, Tamilnadu also sparked off debates and arguments on the safety of schools in the country during 2004. Similarly the fires in marriage halls that occurred in

Dabwali, Haryana during 1995 and in Trichy, Tamilnadu during 2004 killed 500 and 65 people respectively. One would not have forgotten the Upahar theatre fire tragedy that took place in New Delhi during 1997. Human life losses in these various types of buildings in India have highlighted the need for studying or reviewing the fire safety of various buildings. The causes for such losses vary in each incident. While in marriage hall fires the construction of roof was the issue the provision and upkeep of electrical systems were criticized for theatre fire. The lack of fire protection system and adequate exit arrangements were the common contributors in all these incidents.

As an aftermath of fire incidents in occupancies like schools, marriage halls etc the state governments have requested the fire services officials to carry out fire audits. Considering the number of occupancies to be inspected and limitation in availability of fire service force some of the state governments like West Bengal have permitted external agencies to carry out fire (Safety) audits and submit reports to government for issuing no objection certificate. The fire audits for issuing no objection certificate needs to be based on National Building Code of India.

<b>Year</b>	<b>Number of fire accidents</b>	<b>No. of lives lost</b>
1996	12741	72
1997	13678	187
1998	15146	90
1999	16367	72
2000	16987	47
2001	17697	112
2002	18264	79
2003	16109	89
2004	16136	249
2005	15093	99

Source : Tamilnadu Fire & Rescue Services

<b>Name of the company</b>	<b>2004 -05</b>	<b>2005-06</b>
New India Assurance	3270	6010
Oriental Insurance	3520	2800
National Insurance	1441	2465
United India Insurance	1524	1807

Source : Annual reports of the insurance company

## **Fire Safety Audit - Concept**

According to Fire Protection Association, UK fires at work have three causes:

- Deliberate act
- People are not alert to the fire hazards
- Carelessness of the people

These causes can be eliminated by systematic critical identification of fire risks, evaluating them based on their impact and review of existing passive and active fire protection measures. A Fire Safety Audit or Fire risk assessment is a structured and a systematic examination of the work place to identify the hazards from fire. This includes all the components of the system viz. management policy, attitudes, training, design (Process, Mechanical, Electrical, etc.) aspect, layout and construction of the plant/ building, operating Inspection & Maintenance procedures, emergency plans, personal protection standards, accident records.

The fire safety audits can be conducted by external agency or by authorities or by internal team depending on the purpose and periodicity.

In India fire audits are conducted by third party for the purpose of issuing statutory clearance for occupation of the high rise buildings. However non- industrial buildings are not statutorily required to carry out similar audits as long as there is no change in the building. Many of the high rise buildings occupied by the service industry view the property damage and business interruption due to fire and other allied risks seriously and are also bound by the established corporate safety philosophy. Such safety conscious and forward looking companies carry out fire safety audits once in three years with the help of external agency with required expertise based on national and international standards. National building code also recommends for periodical fire safety inspection by the key personnel of the occupants of the building to ensure fire safety standards. Such inspections can be carried out by internal team based on the input provided by National Building Code. In case of industrial buildings the statutory authorities insist for fire safety audits by external agencies depending on the type of activity and nature of materials handled in the buildings.

Work place regulations in other developed countries like UK insist for similar fire risk assessment for all work places. For example The Fire Precautions (Work Place) Regulations 1997 warrants that the employer should record the fire risk assessment in case more than five people are employed and such records should be available for inspection by the authority. Fire risk assessment should be reviewed if changes are made in the work places which have effect on the fire risk.

## **Approach**

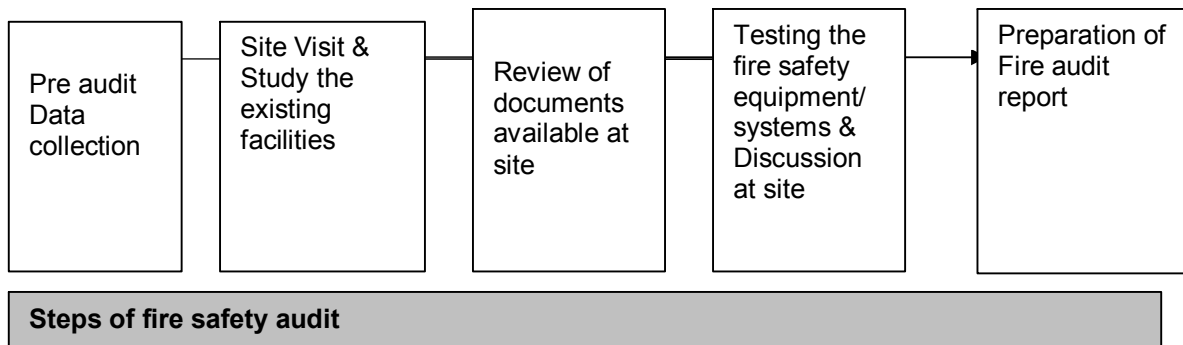
The fire safety audits conducted by fire services in India for issuing fire license or no objection certificate mainly look at the fire protection system available at the premises, the fire escapes, and the accessibility for fire fighters and fire engines to reach remotest and vulnerable points. However a comprehensive fire safety audit can cover various aspects which are related to design, operation and maintenance of the facilities and even the review of inherent fire hazards associated with the normal day to day business operations. Therefore a team of experienced experts with the understanding of basic fire safety principles, fire safety audit technique, and knowledge relating to the particular work place are to be employed to carry out fire safety audits. The scope and methodology discussed in this paper is based on the guidelines provided directly

or indirectly by Fire Precautions in Work Place regulations at workplace, UK, National Fire Protection Association, USA, National Building Code of India, Bureau of Indian Standards and on the experience of the author who has carried out detailed fire safety audits/ fire risk assessments in India and abroad.

The scope of the fire safety audit should cover the following:

- Identify all significant fire hazards
- Identify the people who are at risk from each hazard
- Evaluate if existing control measures reduce risk to a tolerable level
- Determine the required additional control measures required
- Availability of adequate means of escape from the premises in case of fire
- Availability of suitable fire detection and fire fighting facilities
- Availability of suitable emergency plan detailing responsibilities and actions of key personnel
- Training, information and instruction to all occupants of premises about fire safety
- Upkeep and testing of all fire safety equipment and precautions

The methodology of conducting fire safety audit or fire risk assessment is based on the stage of construction or condition of the premises at the time of audit. In general the audit is conducted as depicted below:



### Identifying the fire Hazards

Fires occur when the three things viz. a source of ignition, fuel and oxygen are present together and the fire risk could increase depending on the proximity of these materials to each other. While the oxygen presence in the air is the likely possibility some of the chemicals can also generate oxygen because of their reaction. The auditor should be able to identify such chemicals and situations based on his knowledge in the subject. The potential sources of ignition like naked flames due to smoking, matches, gas welding, heaters, arson, hot surfaces, friction and sparks due to spark electricity, electrical contacts etc. can be located based on the field visit, details regarding operation and maintenance activities carried out in the premises. Any substances which can catch fire in the form of solid, liquid and gaseous state can be considered as fuels. The fire audit should identify potential fire hazards based on the location and handling of above substances.

## Identifying People at risk

The risks to people from fires depend on the smoke and fire spread and available means of escape. The fire auditor should look for the following during his audit:

- The likely speed of growth and spread of any possible fire and associated heat and smoke, toxic vapors etc.
- The number of people present in the area
- Detection and communication arrangements
- The number, size, construction and location of fire exits
- The means and measures to ensure they reach exits and escape safely

For the above purpose the points mentioned by National Building Code of India (Part IV-Appendix D) can also be used. The some of the points identified by NBC are given in the **table 3** for reference.

**Table 3 : Fire Safety features highlighted by NBC for high rise buildings ( Above 15 m height)**

### Facilities

- Building Construction
- Lifts
- Basement
- Service Ducts / Shafts
- Refuge area
- Electrical Services
- Gas Supply
- Illumination of means of exit
- Transformers
- Air conditioning
- Boilers / Boiler Rooms

### First Aid & Fire Fighting Appliances:

- Fire Alarm System
- Lightening Protection
- Fire Control Rooms
- Fire Officer / Supervisor
- House keeping
- Fire Drills
- Compartmentation
- Materials for Interior decorative / Furnishings

### Procedures & Plans

- Drills
- Signs
- Fire Safety Plan
  - Fire Command Station
  - Communications and Fire Alarm
  - Fire Safety Plan Format
  - Duties of Fire Safety related personnel's
  - Fire Prevention and Fire Protection Programme
  - Building Information Form
  - Representative Floor Plan
  - Fire Safety plan

## Evaluating the risks

The fire risks identified and assessed semi-quantitatively based on the existing risk control measures that are already in place. The risks will be categorized low, medium and high which will help the auditors to suggest the additional risk control measures in order to reduce the risk to an acceptable risk level. As Indian statutes do not talk about acceptable risk levels international values may be adopted depending on the type of occupancy. Many of the developed countries accept a larger fire once in ten thousand years in occupancy. Even if accepted risk levels are not adopted the categorization of risks will help in prioritizing the implementation of additional risk control measures.

The evaluation of fire risk in each building or block of occupancy can be done either qualitatively and quantitatively. The quantitative estimation of risk can be done by using matrix method. Each risk or situation to cause a fire can be measured by a numerical score based on the estimated frequency of each possible fire occurrence and its severity on a pre-determined 4X 4 matrix or 5 X 5 matrix. The average fire risks can be calculated for every building based on the total number of risks. The average risk values can be used to categorize the building or block as low, medium or high risk.

The categorization of building can be done based on the risk score as shown below:

<b>Risk Rating scores</b>	<b>Risk Category</b>	<b>Ranking</b>
Less than 15 %	Low	Excellent, efforts required to sustain good practices
16% to 60 %	Normal	Scope for improvement exists
61 % to 100 %	High	Attention is required to address the existing hazards

In addition to matrix methods the other tools like Hani- Rafat calculator is also used internationally to evaluate the risks.

To avoid detailed and cumbersome assessment which requires the help of experienced experts qualitative risk assessment can be carried out. The risks can be categorized qualitatively based on the observation of the team. The categorization suggested by The Fire Precautions (Workplace) Regulations 1997 (as amended), UK (shown below) can be used for the purpose.

<b>Qualitative Risk Categorization</b>	
Low	Areas where there is minimal risk to persons' lives, where the risk of fire occurrence is low, or the potential for fire, heat and smoke spreading is negligible and people would have plenty of time to react to an alert of life.
Normal	Areas where an outbreak of fire is likely to remain confined or spread slowly with an effective fire warning allowing people to escape to a place of safety
High	Areas where the available time needed to evacuate the area is reduced by the speed of development of a fire e.g. highly flammable or explosive materials stored or used in bulk quantities, also where the reaction time to the fire alarm is slower because of the type of person present or the activity in the work place e.g. where elders, physically persons stay or people sleeping in the premises etc.

The above categorization is a simple technique and is subjective. Such assessment may sometimes lead to ambiguity.

#### **Additional Risk control measures**

After reviewing the existing risk control measures the additional risk control measures can aim at reducing the possibility of ignition, to minimize the potential fuel load in the premises or assist persons to escape from the effects of a fire in case it occurs. They can be categorized in a number of ways:

- Fire Safety management systems
- Means of escape
- Staff training
- Fire warning systems
- Means of fighting fire

The selection of control measures should be based on the acceptable risk levels. In case the risk is the possibility of a fast growing fire, potential control measures can be either one or any combination of the following:

- Shifting the hazard/ facility to a place where damage can be minimum
- Providing additional exit for escape of the occupants
- Providing a detection and alarm system for early detection
- Training the people on safe working practices
- Providing appropriate fire fighting equipment/ fixed installation as per standards for example high velocity water spray system for a oil cooled transformer located in the basement of a high rise building

In general the recommendations can be based on the statutory requirements, codes, standards and good safety and engineering practices.

## Report Preparation

The report should give the full picture of the facilities inspected, the business carried out, identification and evaluation of fire risks and the additional risk control measures. The report can be used as the basic document for preparing the action plan for the organization which occupies the premises. The simple format of the fire safety audit/ fire risk assessment report is given in **table 4** for reference.

<b>Table 4 : THE RISK ASSESSMENT REPORT FORMAT</b>	
Name and Address of Premises	:
Owner/ Employer/ Person in control of workspace	:
Telephone Number	:
Use of premises	:
Date of Risk Assessment	:
General Statement of Policy	:
Management system	:
General Description of the Premises	:
Identification of Fire Hazards	:
Identification and location of those at risk	:
Evaluation of Risk	:
Significant Findings	:
Actions Taken to remove / Reduce Risk	:
Signed	:
Print Name	:
Date	:

In addition to the detailed fire safety audit periodical inspections can be carried out internally by a selected team of occupants of the premises. The points of inspection can be in line with National Building Code (Appendix F) or other statutes like Factories rules or Fire Protection Manual of Tariff Advisory Committee.

## Utility for Insurance purpose

The insurance market particularly the fire insurance was driven by the tariff till the end of 2006. However the fire insurance has been de-tariffed by Insurance Regulatory and Development Authority (IRDA) of India since January 2007. Though the terms and conditions of the existing insurance contracts will continue till March 2008 the insurers are allowed to rate the organizations based on their individual risk level. While the erstwhile tariff was based on the overall experience of the particular industry like engineering, chemical industry etc presently the insurance companies rate the risk based on the risk exposures and hence consider the efforts taken by the insured towards the control of fire risks. Most of the insurance companies fix their rates based on the risk inspections carried out by the risk management consultants. In addition to obvious positive features like provision of fire protection systems the other factors like age and material of construction of the building, house keeping, proximity to fire station, good safety systems and practices, lack of ignition sources, safe electrical systems, access to the building, emergency planning, periodical mock drills, training to handle safety systems etc. Some of the insurance companies also offer the risk management services like fire audit to their valued clients as value addition to their insurance coverage. Carrying out fire audits/ fire risk assessment and implementation of important recommendations will help an organization to get an attractive lesser fire insurance premium rates.

## Conclusion

Carrying out fire safety audits before occupation of a building by an expert and experience team can pay dividends to an organization. . In an era of highly competitive business environment any interruption due to fire can be catastrophic. A recent fire in a multi-storeyed building occupied by an IT software company in Chennai with out getting fire license serves as testimony to the above fact. Similarly periodic fire audits can not only prevent the losses of human lives and property but also bring down the cost of insurance to a greater extent. Fire Safety audits with quantitative risk assessment by using internationally accepted techniques will make the management of any organization to appreciate the need for fire safety measures and treat the recommendations with respect.

## References

1. National Building Code of India 1983
2. The Fire Precautions (Work Place) Regulations 1997, UK
3. Annual reports of Insurance companies
4. Fire statistics provided by Tamilnadu Fire & Rescue Services
5. Accident statistics provided by National Crime Research Bureau, Home ministry, Govt. of India
6. Press reports
7. Fire Protection Manual of Tariff Advisory Committee
8. Circulars on de-tariffing issued by Insurance Regulatory and Development Authority of India
9. Fire Safety Audit reports of the author

## About the author



**J. Ramesh Babu** is a chemical engineer with post graduation qualification in Business Administration. He holds the diploma in industrial safety. He is an Associate of Insurance Institute of India and Associate of Institute of Risk Management, UK. He has the experience of about 20 years in operations and risk management consultancy. He has conducted studies in the area of fire safety, process safety, insurance planning, risk and reliability study for a number of occupancies. He has fire audits, fire risk assessment studies and specialized fire protection design/ review studies for various industries like refineries, chemical, engineering, IT sector etc located in India, Thailand, Gulf countries to his credit. He has carried out a number of major fire investigations on behalf of insurance companies. He has conducted three hundred training programmes on various topics of risk management. He has presented papers in seminars held in India, Sri Lanka and Singapore. He is presently working as Dy. General Manager- Risk Services in Cholamandalam MS Risk Services Ltd., Chennai, India