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Factors Influencing Fire Safety in Brazil

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Abstract

Research was conducted on factors influencing fire safety in Brazil and how implementation of a national fire incident reporting system could help. Review of fire incident reporting systems from the United States, United Kingdom, Finland, Singapore, and Hong Kong revealed several attributes, which if implemented, could help improve the fire problem in Brazil. However, research suggests that several other factors need to be addressed first, including the challenges associated with favelas, fire safety culture, fire regulations and fire service resources.

Executive Summary

In many developed countries, a national fire incident reporting system has been implemented to collect data on fires. Data are then used in support of several fire safety activities, including to: support building and fire regulation development, characterize the fire problem for resource allocation purposes, and identify what sectors of the population are most at risk from fire and why. However, in developing countries such as Brazil, implementation of nation-wide fire incident reporting systems have not been successful. This Interactive Qualifying Project (IQP) looks at issues which may be impeding the implementation of a national fire incident reporting system in Brazil and identifies factors that could potentially help address the fire problem. In particular, major issues investigated included fire safety culture and fire regulation, and economic, governmental, environmental, and demographic factors.

A big issue associated with fire safety regulation is fire safety culture. We define fire safety culture as the amount of attention and concern the fire issue garners with the public, industry, and the governmental officials responsible for regulating them. Problems with fire safety culture can lead to negative social and legislative effects. In Brazil, a lack of interest appears to have contributed to a variety of factors, including absence of well-marked evacuation routes, exit signs, emergency notifications, and regulatory enforcement. If the fire safety culture were stronger, and government took more active responsibility for enacting, revising, and enforcing fire regulations, there could be a decrease in certain fire-related incidents.

The problem with the regulation of fire safety codes is partly due to the fire safety culture of the government. In addition, the lack of accurate and usable fire incident data makes it very difficult to establish progressive national fire safety codes or regulations. This inhibits Brazil from using performance-based codes like many developed countries have implemented. Furthermore, a lack of resources significantly impacts what can be done about the fire problem. It can affect the fire brigades by forcing the shut-down of stations or laying off of personnel. Also, because of a lack of resources, often times there is not sufficient funding for programs to; specially train personnel, work on infrastructure

projects, and to encourage fire safety procedures to the general public. However, Brazil has been experiencing a continually improving economic situation. Brazil's improving economy could result in additional funding for the fire and rescue services.

There are also urbanization factors that play a role. One of Brazil's main urbanization factors relates to the city structure, more specifically, the prevalence of favelas, or informal housing. The problems in favelas include unpaved roads, inadequate water supplies, and population and structure density. Each of these factors contributes to the fire safety problem. The favelas make it very difficult to fight fires in part because they are poorly constructed with little regard for fire safety and fire regulations. It is unlikely that Brazil will be able to maintain an acceptable standard of fire protection for the public while favelas litter the landscape of its major cities.

The demography of Brazil also presents challenges to establishing an effective fire reporting system. Brazil's population density varies greatly by state with the most dense states have over 100 people per km^2 and the least dense states having a population density of under five people per km^2. The significantly more dense areas have very different problems related to fire incidents. For example, emergency vehicle access to the incident. Maneuvering vehicles through cities to get to the fire-related incident can be a challenge, resulting in poor performance by the fire and rescue services. Another demography-related problem that is investigated is the economic breakdown and wealth distribution. There is a large income inequality in Brazil. This causes a large inequality in coverage from the fire and rescue service. The wealthier areas receive more attention than the areas of a lower income.

In order to make recommendations for Brazil on how to move closer to implementing a fire-related incident reporting system, successful systems were analyzed; the United States, the United Kingdom, Finland, Singapore, and Hong Kong. The fire services of each of these municipalities have qualities that we feel, if implemented properly, could help to resolve some of the aforementioned problems that currently affect Brazil.

Authorship

It is the opinion of both partners that this IQP report is the result of equal work between us. We believe that both members of the team should receive equal credit for completing the following report. The following describes the major contributions made by each team member.

Jeremy Francisco focused on gathering information and collecting sources with regards to Brazil and fire safety culture. This includes most of the research needed to create the mind map of Brazil, as well as conduct the analysis of the fire problem. Sections written by Jeremy Francisco include the Fire Safety Culture of Brazil, the analysis of the effects of the environment of Brazil on the fire problem, as well as the analysis of the fire services in Singapore.

Marissa Imperiali focused on gathering information and collecting sources with regards to four other municipalities included in analysis, Finland, United Kingdom, Hong Kong, and Singapore. This includes extensive research and background information on fire reporting systems and their operational structures. Sections written by Marissa Imperiali include the analysis of the Government in Brazil with regards to the fire problem, as well as general demographic analysis, the analysis of the fire services and reporting systems in Finland, Hong Kong, and the United Kingdom.

We would also like to acknowledge the efforts of Barbara Hall for her contributions in NFPA research, as well as her assistance helping Marissa with the United States analysis section.

Both partners of this IQP worked to complete significant portions of this IQP together including, the introduction, background, methodology, recommendations, and conclusion of the report. These sections as well as our mind map detailing the fire problem in Brazil reflect the creative input of both members of the project.

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Glossary

ABNT – Brazilian Association of Technical Regulations

AL – Aerial Ladder

BVPI- Best Value Performance Indicator

CESP - Companhia Energética de São Paulo

CPL – Combined Platform Ladder

EDI – Electronic Data Interchange

EMS – Emergency Medical Service

FDR1 – Fire Data Report 1

FDR2 – Fire Data Report 2

FDR3 – Fire Data Report 3

FSR – Fire Statistics and Research

GDP – Gross Domestic Product

GIS – Geographic Information System

HAZMAT – Hazardous Materials

HMFSI – Her Majesty's Fire Inspectorate for Scotland

IPEA – Research Institute Applied Economics

IQP – Interactive Qualifying Project

IRS – Incident Reporting System

LFAV – Light Fire Attack Vehicle

NFIRS – National Fire Incident reporting System

NI – National Insurance

NLC – National League of Cities

ODPM – Office of the Deputy Prime Minister

PL – Pump Ladder

PPE – Personal Protective Equipment

PRA – Probabilistic Risk Assessment

RMV – Rapid Mitigation Vehicle

SCDF – Singapore Civil Defense Force

TFV – Tracked Firefighting Vehicle

USFA – United States Fire Administration

WPI – Worcester Polytechnic Institute

1 Introduction

Fires have been a major threat to property and life throughout the history of civilization (Ramachandran & Charters, 2011, p. 7). In the modern world, many governments use some portion of their resources to help protect the public from the threat of fires. This may come in the form of supporting a fire service, enacting building and fire regulations, and other such measures. Often, governments collect data on the fire situation to help identify critical needs in order to more effectively allocate resources. However, not all governments collect data that can be critical for characterizing the fire problem for resource allocation: understanding where fires are occurring and what the major contributors are. Is the problem associated with fire-fighting infrastructure (e.g., water supply, equipment, staffing, training, etc.)? What role do building characteristics play in accelerating or inhibiting fire growth inside of and between buildings? What are the best strategies to protect and evacuate the people inside and contain and suppress the fires? Gathering such information helps paint a picture of the overall fire problem by helping to identify who is at risk from fire and how, why they are at risk, and what measures can be taken to mitigate that risk.

This Interactive Qualifying Project (IQP) set out to investigate how implementation of a fire reporting system in a developing country could potentially help address the fire problem. The country selected for analysis was Brazil, where there are major factors inhibiting the success of a national fire reporting system. Those factors were investigated with the purpose of recommending changes that could be made to dramatically improve Brazil's fire problem without forcing a national fire reporting system on an unprepared Brazil. A particular emphasis was placed on the larger cities where more data are available. Brazil's fire service, their fire incident reporting system, and the public's opinion on the dangers of fire were investigated. In addition, fire reporting systems in developed countries were also researched. Social, political, cultural and economic issues were also investigated in Brazil and the countries identified for comparison. By understanding the situation in each country, and by analyzing their fire and rescue services along with their fire reporting system, the aim was to identify potential changes that can be made to the procedures used

in Brazil to improve their understanding of the threat of fire and to better allocate resources appropriate to the need. Furthermore, by evaluating factors such as the public's concerns, the government's role in the fire service, environmental issues related to the fire problem, and demographic data, recommendations regarding how best to implement these changes can be made.

2 Background

Fire Incident Reporting systems are a technological way for the fire service to gather data regarding fire incidents and the actions carried out in an emergency situation, store the data for analysis, and report the data to the public. These systems aim to organize as many details of a fire incident as possible to accurately analyze all factors involved in the situation. Examples of this data include the origin of the incident, what caused the incident, what fuels were present, the extent of damage, numbers of injuries and deaths, and more (Greene, Smith, Levenson, Hiser, & Mah, 2001).

This data can then be assessed by professionals to evaluate the performance of the fire-services in reaction to a fire incident, as well as the fire resistance of the property or properties involved. The evaluation is then made available to authorized individuals, who (in the United States) include legislators, members of the fire service, and the media, along with others listed in Appendix G (United States Fire Administration & Federal Emergency Management Agency, 1997). Said individuals use these evaluations in many different ways; examples include updating or creating new safety regulations, improving the performance of the fire service, educating the public about region specific hazards, etc. One specific example would be the way the state of Massachusetts targeted cases of vehicular arson by using the analysis to create and implement a new law. (United States Fire Administration & Federal Emergency Management Agency, 1997).

In the United States, the National Fire Incident Reporting System (NFIRS) requires that fire departments record statistics from the incidents they respond to. These statistics are recorded using the form in Appendix H which includes the origin of the incident, what caused the incident, what fuels were present, the extent of damage, numbers of injuries and deaths, and more (Greene, Smith, Levenson, Hiser, & Mah, 2001). These statistics are then organized and recorded into databases. The analyses of these databases yield results that have many practical applications. Examples include updated building and fire codes and regulations on consumer products. The National Fire Incident Reporting System, as well as ODMP in the United Kingdom, and systems in other countries, then submits a yearly report of the data collected to the Geneva Association for multi-national analysis.

The Geneva Association, an international think-tank of the insurance industry, conducts research relating to risk analysis, using fire data reported by individual countries. Most countries that respond to and complete the annual survey are developed. The majority of them are European but the list also includes the US, Hong Kong and Singapore.

However, our research yielded little indication of fire reporting in a number of developing countries, including South Africa, India, and Brazil. This could be a result of our searches in the English language in the case of India and Brazil, or that a description of an incident reporting system was missing from the literature we were able to review. This was the case is our preliminary research of Brazil, in which we were unable to find a reference to a fire incident reporting system. It was not until contacting Professor George Braga of the University of Brasilia and the Federal District Fire department that we were made aware of the current reporting system status of Brazil.

According to Professor Braga, currently, each state in Brazil has its own fire incident reporting system, which is collected by a federal agency once a year. Combining and organizing these statistics was and still is an issue because they are collected in various ways. Because of this, in 2008, the state fire departments worked together to create a uniform reporting system to be used at a national level. However the departments are still working on implementing this system, as it is completely voluntary that the fire departments adopt it. It seems that reporting structure and resources are key issues inhibiting the implementation of the national reporting system.

Implementing a uniform national reporting system would allow for the creation of a database containing the fire data of the entire country of Brazil. In the United States and in other developed countries, such fire incident databases are analyzed by qualified professionals to assess a variety of issues, including what building features seem to be helping and not, which segments of the population are most at risk, and how resources can be allocated to help. This does not seem to be happening in Brazil due to the lack of a report system and of qualified professionals.

Since statistics are not nationally gathered and analyzed Brazil lacks many of the benefits that exist in countries with adequate reporting systems. Some of these benefits are

updated building and fire codes, fire prevention programs, and applications for public safety (National Fire Protection Association, 2004). Without the development and implementation of safety measures using region specific data, it is difficult to adapt fire safety policies to best protect the population of the country. Looking at Figure 1 , taken from An analysis of the fire safety codes in Brazil (Tavares, 2009), it is noticeable that there are an increased number of fires; this could be in part because of inadequate implementation of correct fire safety measures. In São Paulo, the number of fires doubled from the year 1990 to the year 2000. It is shown to be practically the same for the Rio de Janeiro region.

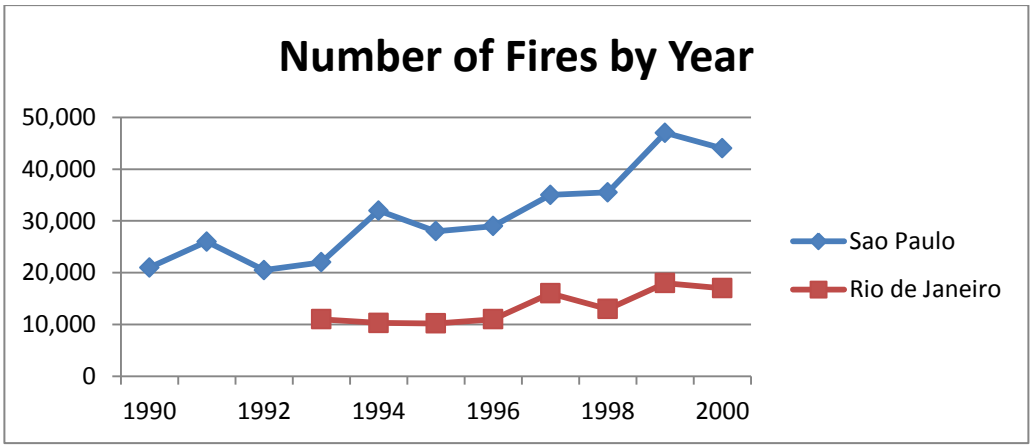

Figure 1: Number of Fires by Year

2.1 Nature and History of the Fire Safety Focus

The issue of public safety in case of fire in Brazil became a concern in the 1940's with the creation of the ABNT (*Associação Brasileira de Normas Técnicas*), or the Brazilian Association of Technical Regulations, which focused on the development of fire safety codes and established a Brazilian presence in the International Safety Regulations Committee (Tavares, 2009, p. 750). In the 1950's, the city of São Paulo required architecture firms and construction contractors to provide the local fire departments with the plans for the building. Fire extinguishers were to be placed according to the recommendations from the fire departments.

In an attempt to properly regulate the locations of fire-extinguishers, laws that defined the variables involved in selecting the location were passed in the early 1960's

(Tavares, 2009, p. 750). Little progress was made in the fire safety codes until two accidents in the Andraus and Joelma buildings in the city of São Paulo in 1972 and 74, respectively, with a total of 195 deaths and 329 injured, raised social awareness. In response to the fires the federal government passed a law allowing them to create associations to work with the local fire departments to improve safety, specifically focused on prevention and extinction of fires. Also, the city of São Paulo created the *Departamento de Defesa Civil* (Department of Civil Defense), which was designed to work with the Planning Secretary and propose improved safety measures. The state of Rio de Janeiro responded to the two fires in São Paulo as well, with the passage of regulations in 1976 concerned with the installation of fire doors, fire extinguishers, sprinkler systems, and clearly defining emergency stairways (Tavares, 2009, p. 751).

Since the major fires of the Andraus and Joelma buildings, other major accidents have occurred, such as a 23-story building in São Paulo which resulted in the deaths of seventeen and the injuries of fifty three in 1981, and the CESP (Companhia Energética de São Paulo) or the company for the energy supply of São Paulo (Tavares, 2009, p. 751). The government responded the same way to both: updating regulations and implementing new ones to address more complex issues such as fire walls and proper lining materials. However, there is evidence that even in more recent times there is a, "...lack of enforcement of the law" (Tavares, 2009, p. 753)

As recently as 2001 in Rio de Janeiro, a fire occurred at a TV studio with over 300 occupants. No alarm was sounded, the sprinkler system did not activate, and throughout the fire the emergency exit remained locked, resulting in 26 injuries (Tavares, 2009, p. 751). According to Tavares, it is safe to assume that much of urban Brazil lacks functioning alarms, sprinkler systems, and smoke detectors, as well as not having emergency prodecures in place.

The cities of Brazil have another issue that has contributed to the fire problem in recent history. Large areas of informal housing, called favelas, litter the cities of Rio de Janeiro and São Paulo. Favelas are unplanned sections of land, where the population has created makeshift homes. These homes are made with no knowledge of construction

regulations, which dramatically increases the risk of fire. It is also common to see favelas "… spreading up the steep, rocky hillsides where no regular construction could take place (Perlman, 1976)…" which causes natural issues such as landslides.

Favelas are locations for the urban poor to live, and as such have poor living conditions. Table 1 was recreated from Greg O'Hare's and Mechael Barke's "The Favelas of Rio de Janeiro: A temporal and spatial analysis," and shows that basic infrastructure, such as water, sewage, and garbage collection is lacking for large percentages of the population. Also shown are living conditions in the home, such as the number of rooms per household and socio-economic factors such as illiteracy (over age 15), varying levels of education for the head of house, and mean incomes (O'Hare & Barke, 2003).

Table 1: Households and Environment

	All City	All favelas	Top 10 Favelas	Bottom 10 Favelas
% inadequate water	3.9	15.4	2.6	58.3
% inadequate sewerage	8.9	36.7	6.8	91.8
% inadequate rubbish collection	4.3	21.3	1.6	88.1
Mean no rooms/household	4.8	4.1	5.4	3.2
% HoH with <4 years study	17.2	20.6	14.7	26.8
% HoH with 15+ years study	16.7	1.1	6.6	0.5
% illiteracy over 15 years	6.1	15.4	6.8	28.0
% HH at up to 2 min salary	35.5	72.3	48.6	88.2
% HoH at 10 or > min salary	15.1	0.6	6.7	0.1
HoH mean income (min salary)	5.84	1.7	3.9	1.1

While the socio-economic issues present are important in understanding the populations of the favelas, the inadequate infrastructure is the largest concern shown with respect to the fire problem. By infrastructure we mean factors such as water supply, paved

roadways, and building construction. For example, while only 3.9% of the households of Rio de Janeiro report inadequate water to supply the population, 15.4% of households in favelas do. This means that fire fighters will have a more difficult time combating fires because access to the required resources may be unavailable or ineffective.

The problem of favelas is also located in São Paulo, where in 1994, Pedro Jacobi, a researcher at the Centro de Estudos de Cultura Contemporânea, published a report entitled "Households and environment in the city of São Paulo; problems, perceptions and solutions." The report presents the findings of a 1,000 household survey in the city that examines various environmental problems at the neighborhood level, and respondent's perceptions of these problems as well as the best possible solutions. The survey divided households into six socio-economic strata based on statistical criteria that served as indicators for quality of life, with stratum one being the highest quality and six the lowest. A more detailed description of the survey is located in the Analysis section of this report; however it is important to detail some of the results now.

Table 2: Provision of Basic Infrastructure and Services, according to Households' Socio-economic Stratum

Infrastructure and services	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Stratum 5	Stratum 6	Total
Paved roads and sidewalks	90.4	96.6	83.1	73.2	58.6	60.5	77.07
Public water supply	94.2	97.7	94.9	96.2	91.6	93.5	94.68
Public sewage system	92.3	97.7	80.9	73.2	60.2	58.1	77.07
Public lighting	94.2	98.9	94.5	92.5	86.1	84.7	91.82
Electricity	94.2	97.7	97.1	95.8	89.6	94.3	94.78
Solid waste collection	92.3	97.7	93.3	87.7	87.6	89.3	91.32
Total house-holds sampled	52	87	272	213	251	125	1000
Heavy traffic	62.0	70.1	63.2	52.6	35.1	41.5	51.7

Table 2 was recreated from Pedro Jacobi's report above, and shows that while 90.4% of households in the most quality sectors have paved roads and sidewalks, only 60.5% of the lowest quality sectors do. This is most likely the result of overcrowding; since space to build homes in an increasingly dense city is rare, houses are built as close to each other as possible, while still allowing foot traffic when necessary. This leads to homes where occupants only have access to a public road by passing through alleyways in between other homes. The close proximity of these structures creates situations where a fire could easily spread, and their distance from paved and accessable roads increases the difficulty for the fire brigades to combat the fire (Jacobi, 1994).

While slums are not uncommon in urban areas of developed countries, they pose a more significant threat in a developing nation such as Brazil. This is in part because of the lack of infrastructure accessable to these slums, as well as the disregard of building and safety regulations. Perhaps highlighting this issue is the rate at which it is growing in Rio de Janeiro, which is illustrated in Figure 2 (O'Hare & Barke, 2003).

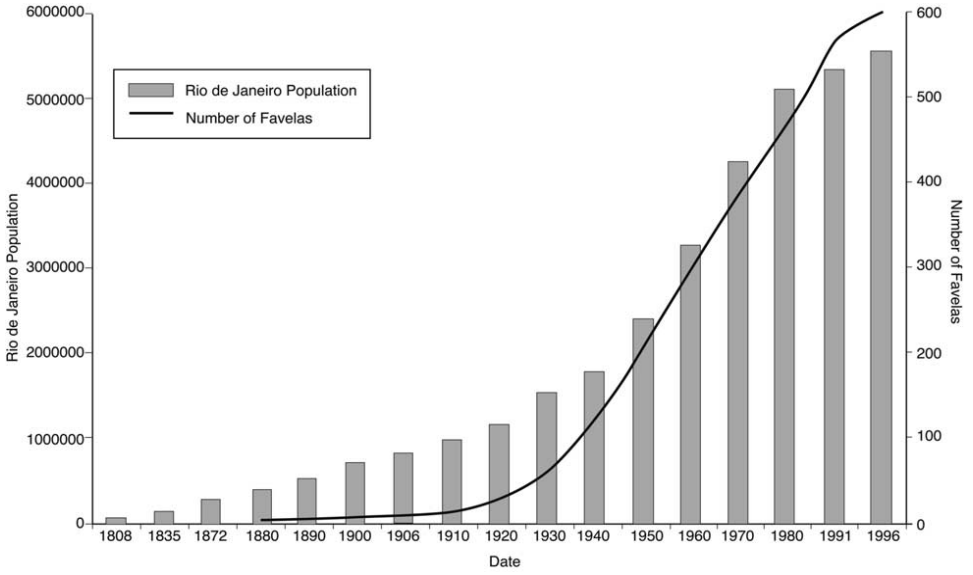

Figure 2: Population and Favela growth of Rio de Janeiro

2.2 Issues Associated with Fire Safety Regulation

The fire safety situation throughout Brazil is complex and requires organization and restructuring on multiple fronts. The major three issues are society's perception of fire risk,

the inadequate support and resources of the government in combating the fires, and the lack of an effective nation-wide fire incident reporting system.

2.2.1 Fire Safety Culture

According to (Tavares, 2009)some of the difficulties responsible for the lack of performance based fire safety codes, and the reporting system to support it, are the perception of fire risks and the laws themselves. In his Analysis of the Fire Safety Codes in Brazil, he surmises that these issues can be described as the "fire safety culture."

"Fire Safety Culture" is the amount of attention and concern the fire issue garners with the public, the industry, and the governmental officials responsible for regulating them. This concept is affected by the amount of fire education and emergency instruction the public receives. For example, in the United States, children and students are taught about the dangers of fire and how to avoid common fire risks. An example of these programs would be the NFPA's Learn Not to Burn, which aims to help children identify what household items could burn them (National Fire Protection Association, 1991). Emergency procedures to take if these risks occur are also detailed, such as "Stop Drop and Roll" from the NFPA's Sparky.org website, which is of course the proper course of action if your clothing should ignite (National Fire Protection Association).

2.2.1.1 Social Effects of Current Fire Safety Culture

This lack of interest can be shown by the common absence of evacuation routes, exit signs, and emergency notifications, which are often mandated in more developed countries, such as the United States (Tavares, 2009). Investigations into the burning of the Joelma building of São Paulo, 1974 suggest that if the occupants were aware of emergency procedures in place, the death-toll of 189 occupants and injuries of 320 others would have been significantly lower. The issue however, is not just that the occupants were unaware of the procedures but rather why; the procedures were unclear, and therefore neglected.

2.2.1.2 Legislative Effects of Current Fire Safety Culture

Because of the rapid industrialization and urbanization of Brazil the national fire safety code does not include detailed safety requirements (Tavares, 2009, p. 749). Furthermore

the regulations contained are often difficult to understand, and even more difficult to enforce. Because the code is inadequate when attempting to standardize regulations across the entire country, some regions and even some cities have produced their own detailed prescriptive codes and regulations. These regulatory codes are very difficult to adhere to because of their great differences. As a result, a disaster may result in the creation of a regulation to help prevent future occurrences in one region, while another region does not implement the same regulation until a similar situation occurs.

An example of poor regulations is that regardless of a building's height, only one staircase is required. Another would be in the requirement that shopping malls, parking garages, and airports in Brazil contain sprinkler systems, but are not required to test them. In contrast, the United States sprinkler systems must be inspected annually, maintenance must be conducted annually, and various forms of testing must occur after 5 years (National Fire Protection Association, 2011).

These issues could be avoided if the national government took responsibility for the safety of the people by constructing, continually revising, and enforcing their own overarching regulatory code.

2.2.2 Economic Issues Regarding Fire Safety

The economy of Brazil is the world's ninth largest by GDP (purchasing power parity), which grew at the rate of 7.5% in 2010 (Central Intelligence Agency, 2011). This steady growth originated in the 1990's when efforts to stabilize the currency, control and limit the inflation rate, and lower the debt load were made (Lyons, Latin America, 2011). Moisés Naím, a senior associate in the International Economics program at the Carnegie Endowment for International Peace, describes the outcomes of the economic growth.

> In Brazil a labor-union leader has presided over an amazing period of social and economic progress. It is also one of the few countries that have successfully managed to reduce economic inequality at a time when everywhere else inequities are deepening. Successive Brazilian governments, of rival political parties, have succeeded in improving education, health and the living standards of millions of impoverished citizens who have now joined a growing middle class. Brazil has an energy policy that has spawned the world's most vibrant biofuels industry. In 1995,

> 15 percent of Brazilian school-age children did not go to school. In 2005, this fell to 3 percent, and today Brazil has practically achieved universal basic education (Naím, 2009).

The improvement of education in Brazil is a big step towards more graduates in the field of fire protection and is evidence of resources being allocated to upgrade the quality of life of the public. However, it is clear that not enough of these resources are allocated to fire safety measures. Brazil is still a third-world country, even with its increasingly first-world economy (Lyons, Latin America, 2011); an economy that should be able to support more comprehensive health and safety regulations.

2.2.3 Benefits of a Reporting System

Because there is no effective national fire reporting system or effort in Brazil, there is no national database to represent the fire problem. However, by using reports created by the media we are able to see rough estimates on the number of destroyed informal housing in specific favelas (informal settlements) of São Paulo in a given 2-year period Table 3.

Table 3: Slum fire damages in São Paulo City, in 2-year period

Date	Favela Name	Destroyed Informal Housing
01/30/2011	Serra Pelada	30
12/06/2010	vila Maria	06
08/26/2010	Jardim Sao Francisco	Not Informed
05/19/2010	Naval	100
01/16/2010	Mundo Novo	Not Informed
12/19/2009	Jabaquara	60
12/06/2009	Agua Espraiada	250
11/02/2009	Paraisopolis	10
10/11/2009	Jaguare	300
10/09/2009	Imigrantes	04
08/16/2009	Guaianases	Not Informed
06/26/2009	Jabaquara	05
05/01/2009	Moinho	Not Informed
04/17/2009	Billings-Jaquara	50

These statistics are media estimations and not exact. They do not contain specific information as to what caused, accelerated, or retarded the fire, what steps were taken by the fire brigades to extinguish it, or estimates of damage to property and life. This information could be used to created codes which target specific dangers which occur at unacceptable frequencies in Brazil.

Without this information the city cannot establish fire codes designed to limit the risk of fire and damages. As a result, even if the fire safety culture was in place, Brazil does not have the necessary database and understanding of its own fire problem to improve the prescriptive codes in place.

2.3 Benefit of Studying

A common trend of industrializing countries is the rapid urbanization and of the population. This process is usually done hastily and with little regard for health and safety concerns. As described above, some of the reasons for the lack of fire safety procedures and regulations are a lack of fire safety culture among the population, a lack of organized research and information exchange, and inadequate structure and enforcement of federal policies. Ultimately, these issues lead to a detriment to the quality of life of the Brazilian public.

By analyzing the root of these concerns, we hope to improve the effectiveness of the fire services. By increasing gathered incident data, and improving the exchange of this information, fire protection engineers should produce regulations and construction procedures that reduce the risk of fire incidents, reduce the rate at which the flames consume the buildings, and decrease the evacuation time of the occupants.

2.4 Assessment of Related Research

In the past there have been numerous studies carried out concerning fire statistics and fire safety. There have been studies about the standardization of fire safety guidelines and compliance data, society's awareness of fire risks, and many other variations of the same theme. One such study was carried out in April of 1998 by the TriData Corporation for the United States Fire Administration, Federal Emergency Management Agency

(TriData Corporation, 1998). The objective of the study was to indicate relationships between characteristics of United States cities and the residential fire rates. The characteristics studied were categorized as relating to environmental, demographic, or socioeconomic data. The residential fire rate data was collected from 1993-1995 in the National Fire Incident Reporting System, NFIRS (TriData Corporation, 1998). This study is a good representation of how Brazil and other nations can use the information that is kept in fire incident reporting systems. However, as a guide for this project it does not quite match. Brazil does not have a national fire incident reporting system that is organized like the NFIRS system in the United States. Also, much of the information that may be gathered is not as accessible as it would be in a more developed incident reporting system. The data needed to carry out the same mathematical and statistical process as the TriData Corporation study is not available. We would suggest that Brazil, after having a fire incident reporting system set up for a few years or collecting significant statistics, run a study much like the one carried out by the TriData Corporation. The study will help to correlate and show which areas are the problem areas and demonstrate which issues should be made into fire prevention programs.

Previous Interactive Qualifying Projects, IQP's, have been used as a means of comparing what we would like to do with the project and what may actually be able to be carried out. There have not been any projects carried out at Worcester Polytechnic Institute, WPI, which cover the same subject area as the project we would like to carry out. We have found two IQP's with focus areas that are similar to, but not the same, as the focus area we have chosen.

The first report is entitled *Societal Awareness of Fire Risks* and was completed in the fall of 2002 (Elliot & Long, 2002). In this report demographic and fire death data was collected for forty-six United States cities; a five year rolling average of the fire death rates was then calculated for each city. The end result of the report had the calculated statistics submitted to the press for distribution across the nation (Elliot & Long, 2002). We looked at the socioeconomic and demographic information compared to fire statistics in Brazil and compared this information with that of countries which are have more successful reporting

systems then Brazil and used the conclusions as examples of the benefits of a national fire incident reporting system.

The second report, entitled *Standardizing Fire Safety Compliance Data*, was completed in the spring of 2003 in cooperation with the Capital Management Branch of the Department of Human Services in Victoria, Australia (DeBiasio, Simpson, & Lauer, 2003). In this project the goal of the team was to "facilitate the communication and storage of data regarding fire safety compliance with the Capital Management Branch of the Department of Human Services." The project was not helpful to us because it worked with improvements in data storage and retrieval, and reporting methods, which are topics to specific for our scope. The final stage of the project also involved addressing the major issues found and justifying the solutions that were selected to be applied. The final proposal of the *Standardizing Fire Safety Compliance Data* project group was to create a centralized database (DeBiasio, Simpson, & Lauer, 2003). The Centralized Database proposed in section 6.1.5 of the *Standardizing Fire Safety Compliance Data* IQP would work well for a database that consisted of pre-incident data (DeBiasio, Simpson, & Lauer, 2003). Pre-incident data consists of the building address, building plans, contacts for properties, what type of facility is located on the property, and any other information that could be pertinent and useful during and after an incident. An example of the type of facility located on the property would be its classification such as residential, commercial, industrial, etc. Pre-incident data is part of the NFIRS database in use in the United States. When fire incidents occur the fire reports associated with them are placed in the correct record for each property that holds pre-incident information and adds to the information.

3 Methodology

The goals of this IQP were to understand the fire safety situation in Brazil, the relative contribution of a national fire incident reporting system to addressing national fire safety issues in Brazil, and the impedances to developing and implementing a national fire incident reporting system in Brazil, and to create recommendations of changes and improvements which should help Brazil overcome the current issues to develop a national fire incident reporting system. These goals were accomplished as follows.

1. Research and analyze fire safety issues in Brazil
2. Identify key issues which must be resolved in order for Brazil to offer satisfactory fire protection to its citizens
3. Evaluate the pros, cons, and attributes of fire incident reporting systems and fire brigades of Countries with more success in fire protection
4. Identify how best to resolve the major issues hindering the implementation of a successful national fire incident reporting system in Brazil which achieves the objectives of reducing fire losses, deaths, and injuries due to fire.

3.1 Research and Analysis

In order to gain a greater understanding of the issues preventing a fire reporting system in Brazil, we researched published material on the subject and attempted to contact subject matter experts to obtain additional data. Of the experts we contacted, Dr. George Cajaty Barbosa Braga, a professor at the University of Brasilia, and Dr. Rodrigo Machado Tavares responded. Both were suggested subject matter experts referred by our advisor, Professor Meacham. Professor Braga answered our questions regarding the current fire incident reporting system in Brazil, including its organization and shortcomings. Dr. Tavares provided a copy of a paper he had published on fire safety regulations in Brazil.

Research included looking at how the economics of Brazil affect the fire service's ability to protect the population, the organizational structure, as well as its pro's and con's, of the fire brigades, and the current regulatory environment. Sources included the Wall Street Journal, papers written by Dr. Rodrigo Machado Tavares, as well as information documented by the Central Intelligence Agency.

3.2 Key Issues

After researching the fire situation in Brazil, as well as the functions of reporting systems, and the analysis of their data, a few key issues were discovered, which prevent the creation of a national fire incident reporting system. These issues included the current state of favelas in Brazil's major cities, technological and educational shortcomings, such as a lack of students studying fire protection engineering, and an inadequate fire safety culture. These issues were researched to determine their causes, and possible solutions.

3.3 Evaluating the Pros and Cons of Fire Incident Reporting Systems

To understand which attributes of reporting systems may be appropriate to implementation in Brazil, we evaluated aspects of fire reporting systems, as well as various forms of organization of fire brigades, from governments in five locations:

- The United States
- Finland
- Singapore
- The United Kingdom
- Hong Kong

These governments were chosen because of the success of their fire incident reporting systems as well as their similarities to the current situation in Brazil. Studying each system provided insight to various problems faced by governments when combating the fire problem, and solutions to them.

The United States was chosen as a focus country for analysis because of its developed and well documented fire incident reporting system known as the National Fire Incident Reporting System, or NFIRS. The National Fire Incident Reporting System, NFIRS, was created in 1976 by the United States Fire Administration, USFA. (FEMA, USFA, NFDC,

1997) It is now managed jointly by the USFA and the National Fire Information Council, NFIC. The current version of NFIRS released for use in 1999 and is version 5.0 (US Fire Administration , 2011). The Federal Emergency Management Agency in cooperation with the United States Fire Administration and the National Fire Data Center released a report focusing entirely on NFIRS. The paper documents the information reported into the system and the type of results the analysis of said information provides. The paper also provides information on the people who are involved with NFIRS whether the ones reporting into the system, the people organizing and analyzing the data, or the people accessing and using the data. The United States' system NFIRS may be used as an example of what to strive for when enacting a fire incident reporting system and also provides examples of how the information collected may be used to lessen the fire safety problem in Brazil when sufficient information is available.

Finland was chosen as a focus country for analysis for a variety of reasons. One such reason is the structure of the fire service. The fire service in Finland is regulated by the Ministry of the Interior however; each municipality in Finland has the chance to decide how their fire and rescue services will be staffed. The three types of fire brigades that are in place in Finland are the professional fire brigade, the half-ordinary fire brigade, and the voluntary fire brigade. This is a similar structure to that of the fire services in Brazil, and therefore provides insight into opportunities for Brazil to make simple modifications which greatly improve the fire services.

We chose to analyze the fire reporting system in the country of Singapore because of its efficiency at collecting and organizing information that allows officials to understand what specific issues their country faces in regards to fire, and where these issues are most abundant. One major outcome of understanding what fire issues are present has led to the SCDF's development of eight custom designed vehicles to tackle issues such as congested traffic and building density, situations often faced in Brazil. The information gathered is then presented to the public in order to educate them and increase their awareness of risk such as applications for mobile devices (such as the iPhone) that illustrate proper reactions to fire situations.

The United Kingdom has recently taken a close look at their fire-related incident reporting system because they felt that it could be modernized in order to make it more efficient and effective. An extensive study was done in 2005 with multiple reports discussing their findings and making suggestions on how to proceed with implementing a new system. These reports provide sufficient information to compare issues discovered in the United Kingdom's fire-related incident reporting system, with the nation-wide fire-related incident reporting system currently being prepared for implementation in Brazil.

Hong Kong has a very successful fire and rescue service that continually aims to improve their performance. They have a method, called targets and indicators, of setting a level of performance they deem attainable and satisfactory. Having accessible and understandable data enables the fire and rescue service of Hong Kong to assess their performance and discover any areas that may need improvement.

3.4 Identifying Possible Solutions to Key Issues

Finally, after analyzing the methods used by more successful countries to solve similar issues as to those that Brazil is currently facing, we created a list of recommendations which, if implemented, should improve the overall fire safety of Brazil, and position the country to create a national fire incident reporting system. These recommendations were made based on the procedures used and actions taken to solve similar issues. These issues were determined to be similar based on environmental factors, economic pressures, demographics and government correlations.

4 Analysis

Analysis was undertaking in two primary areas: the fire safety situation in Brazil and attributes of a fire incident reporting system that can help to improve a country's fire safety situation. The first part of the analysis focuses on the range of factors which influence fire safety in Brazil, as overviewed in the Background. This discussion is presented in Section 4.1. The second part focused on fire incident reporting systems and fire department (brigade) factors. This is presented in Sections 4.2-4.6.

There are different technologies that can be implemented into a reporting system, such as; databases, electronic entry of data, submitting print reports, GIS, and utilizing the internet. Each of the different countries that we have looked at uses at least one of these technologies in their reporting system. The United States, United Kingdom, Singapore, Finland, and Hong Kong's fire and rescue services report on fire-related incidents which then get used to make improvements on fire safety codes or the fire and rescue service. Analyzing the data gathered and reported from the fire-related incident site, exposes the areas that need improvement. By analyzing the fire and rescue services and the fire-related incident reporting systems that work in other countries, a set of recommendations can be determined for the best course of action for Brazil.

With reporting systems it is important to identify; what data is required to be reported, when this required data is reported, how it gets reported, and who is responsible for reporting on the fire-related incident. With this information, the relationship between the reporting system and the fire and rescue service for each country is established. This assists in correlating similarities between these countries to Brazil in an effort to decide upon feasible recommendations for Brazil.

What happens to the collected data on fire-related incidents is also very important. We also investigated who uses the report along with; who analyzes the data, how the analysis is carried out, and how the results from the analysis are used.

4.1 Brazil

As noted in the Background, there are a number of issues which influence the fire safety situation in Brazil. To help focus the analysis, and to better understand the relationships, a 'mind map' was used to identify the major issues related to Brazil's fire problem on which to focus. This brainstorming method organized for us Brazil's fire problem in way that made it easier to articulate in this report. Our main findings conclude that there are four major branches of Brazil's fire problem that will be explained in greater detail. These four branches are; fire safety culture, government, environment, and demography. See Appendix J for our mind map of Brazil's fire problem and Appendix K for our mind map of fire reporting systems.

4.1.1 The Fire Safety Culture

As described above, Fire Safety Culture is the amount of attention and concern the fire issue garners with the public, the industry, and the government officials responsible for regulating them, and the beliefs, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure to dangerous conditions. Not only are Fire Safety Culture, and its more generic concept, Safety Culture, an illustration of the public's attentions in regards to safety, but also guides the attentions of the public. Research has shown that there are three levels at which culture can be observed:

I. Basic Assumptions

II. Espoused values

III. Artifacts

Basic assumptions of an object or procedure affect our attitude towards it, which then affects what precautions we take. In a country with a developed Fire Safety Culture, such as the United States, assumptions regarding the safety of an object or procedure can be made because of our basic understanding of risk. This understanding comes from issued warnings. Not only do dangerous products such as vehicles come with many warnings, but products as simple as coils of string come with warning labels describing possible risks associated with them.

With a larger understanding of objects or procedures and their risks, people can begin to make assumptions on the risks and dangers of other objects and procedures. These assumptions then guide the behavior of the public, their perceptions regarding risks, and how they feel about taking them. This culture then becomes taken for granted, and actions based on other assumptions are difficult to understand (Guldenmund, 2000).

These basic assumptions are not necessarily in regard to safety, yet still affect the safety culture. “If in some organization written rules or procedures are considered futile, safety rules will be to (Guldenmund, 2000).” This is to say that society’s assumptions control our attitudes towards an object or behavior, which clearly affects intentions and behaviors taken.

Attitudes are an example of society’s espoused values, along with policies, training manuals, procedures, formal statements, bulletins, and accident and incident reports. These values determine whether or not an organization, such as a business, or community have emergency training manuals, or planned emergency procedures; whether or not an investigative or regulatory body produces an accident or incident report after an emergency situation and the effect of this report in determining changes in emergency procedures in order to improve their effectiveness.

Finally these espoused values or attitudes control the final level of safety culture, the artifacts. Artifacts are physical reactions to our attitudes. Artifacts in this context are personal protective equipment, informative posters, dress codes, etc. If a group’s attitude toward an object and procedure is that it has specific and dangerous risks, they may prescribe protective equipment, or attempt the educate others of the risks.

4.1.2 Government

Brazil’s conventional name is the Federative Republic of Brazil and it is a federal republic with powers distributed between the executive, legislative, and judicial branches. The head of the executive branch is an elected president and the National congress and the Chamber of Deputies make up the legislative branch. Then in the judicial branch, the Supreme Federal Tribunal is comprised of president appointed judges.

4.1.2.1 Regulations

Statistics from previous fire incidents are commonly reported into databases and analyzed. The results of this analysis can then be implemented in many practical applications. Examples include public fire prevention campaigns, fire service training programs, and analyses to decide what equipment is needed in each fire service area. In many developing countries there are not organized and efficient systems to collect these fire incident statistics. Since statistics are not gathered and analyses provided for fire protection engineers and other such qualified professionals to use, the developing nation is lacking in many other areas affected by the production of these. Areas affected include the building and fire codes, fire prevention programs, and public safety applications. Without the development and implementation of safety measures using region specific data, it is difficult to adapt fire codes to best protect the population of each region.

In Brazil one such problem is that the fire code requires sprinkler systems to be installed in buildings but it does not require them to be in use (Tavares, 2009). This loophole in the regulations is a clear indication of poor fire safety culture within the legislative officials. Without comprehensive and sound regulations future construction will not be forced to implement new and important safety measures. It has been shown that while the correct fire safety measures are not implemented in Brazil the number of fires has been growing. In São Paulo the number of fires doubled from the year 1990 to the year 2000. It is shown to be practically the same for the Rio de Janeiro region (Tavares, 2009).

In 1940 the Brazilian Association of Technical Regulations (Associação Brasileira de Normas Técnicas) was established. This was the starting point for the development of fire safety codes. Since then, Brazil has actively participated in the International Safety Regulations Committee. The Department of Civil Defense was dedicated to improving public safety, including fires, in response to two major fires, one occurring in 1972 and the other in 1974. Then in the early 90's the Brazilian Committee for Fire Protection (Comitê Brasileiro de Segurança contra Incêndio) was founded. Their responsibilities include; development of the fire program, analysis evaluation of constructive materials resistance

performance to fire, methodology for laboratory tests, and terminology of fire safety concepts.

Brazil is currently using prescriptive codes. Prescriptive codes are easy to apply and enforce but they are not as effective as performance-based codes. "The performance-based codes attempt to provide clearer guidance than the prescriptive codes taking into consideration the actual growing complexity of the architectural designs, which introduces more fire risks," (Tavares, 2009) which is why the United Kingdom, United States, and Japan have switched to performance-based codes. For Brazil, the perception of fire risks and existing laws could make implementation of a performance-based system difficult.

4.1.2.2 Officials

The State Military Police and Fire Brigade is a law enforcement institution established by Brazil. It is part of the executive branch of the federal or state government. Even though it is not part of the Brazilian Armed Forces, the State Military Police and Fire Brigade are militarized, meaning that they are based on military principles. All fire and rescue services and the police force are controlled by the local and federal governments. As a result, often times, there is difficulty in reforming, or any way, improving the police or fire and rescue services.

Mercedes Hinton's article A Distant Reality: Democratic Policing in Argentina and Brazil discusses the current situation of Brazil's police force and how attempts at reforming it fail. Hinton explains some problems that "continue to hinder the development of the police into a professional, accountable and universal public service." (Hinton, 2005)

In 1809, Brazil formed its first full-time police force in Rio de Janeiro at a time when almost half of the city's population was slaves. Therefore, the police force's main job was to keep the slaves from causing any trouble. Then in 1888 when Brazil ended slavery, the police switched focus to protecting the rich from the poor.

Police reform in Brazil is very difficult due to bureaucracies choosing to lobby for policies that push their own agenda. This is true for all other public sector reforms. But Hinton believes the police reform also has the added difficulty of an armed, secretive and

politically strategic bureaucracy. In "Brazil, efforts at police reform to date have been at odds with the patterns of patronage, clientelism, unholy alliances and impunity that continue to prevail at the highest levels of the executive, legislative and judicial branches of government." (Hinton, 2005) When attempts are made at reforming the police departments in Brazil, sometimes some officers will react by:

- foot-dragging
- intimidation of would-be reformers
- boycotting of crime control
- staging crimes

Historically police in Latin America are sometimes selective about what laws they choose to enforce. They also focus most of their attention to groups of people who they believe to be committing the majority of crimes; the poor and the minorities. This is prevalent as a result of high levels of income inequality. Latin America is the region of the world with the highest income inequalities, according to the World Bank (Hinton, 2005).

"The failure to professionalize the police – by promoting modern training methods, adequate salary scales, firm performance criteria and a merit-based career path – is closely linked to enduring political patterns." (Hinton, 2005) Because the fire and rescue service is closely linked with the police force, the fire and rescue service shares some of the same problems when dealing with the government officials that they are subordinate to. Firefighters have been protesting in Rio de Janeiro because they feel as though they deserve an increase in salary and an improvement in working conditions. In an article for The Rio Times, "Rio Firefighters and Police Clash in Protests", Helen Trouton Torres writes about why the firefighters in Brazil are protesting. "Firefighters in Rio receive a monthly salary of R$950. The average salary of a regular firefighter in the U.S. is $3,449 per month (R$5,437)". (Torres, 2011) Torres then goes on to explain that the firefighters have attempted, and are continuing to try, to work with the government to fix this problem.

Unfortunately, since the fire and rescue service in Brazil is under military and government control, firefighters are getting arrested for protesting. Also, "the fire

department will be sued under four articles of the Military Penal Code, for rioting, damage to both property and vehicles, and for hindering relief and rescue". The Military Police Elite Squad treated the firefighters like rioters, using plastic explosives, rifle shots, and tear gas when they had entered the Headquarters of the Central Fire Department during their rally.

4.1.2.3 Resources

The resources available to a fire department have a direct and significant impact on the effectiveness of a fire and rescue service. An article for the Insurance Journal discusses how the economy can affect the fire protection services. "How Economy Is Challenging Fire Protection Services", written by Michael R. Waters, specifically writes about how the current condition of the United States economy has had a negative effect on their fire departments. "Some fire departments faced with funding issues have chosen to shut down their fire stations entirely; reduce firefighter on duty strength; or institute temporary "brown outs" whereby stations or fire companies are shuttered on a rolling basis." (Waters, 2010) Choices have to be made during periods of financial strains that have an impact on all department types. In 2009, the National League of Cities (NLC) conducted a survey that found that most cites are attempting to compensate for the lack of funding by instituting hiring freezes, laying off personnel, or delaying or cancelling planned infrastructure projects. (Waters, 2010)

Even though economic conditions have been poor in the past, Brazil's economy is growing at an impressive rate. "In Brazil a labor-union leader has presided over an amazing period of social and economic progress. It is also one of the few countries that have successfully managed to reduce economic inequality at a time when everywhere else inequalities are deepening. Successive Brazilian governments, of rival political parties, have succeeded in improving education, health and the living standards of millions of impoverished citizens who have now joined a growing middle class. Brazil has an energy policy that has spawned the world's most vibrant biofuels industry. In 1995, 15 percent of Brazilian school-age children did not go to school. In 2005, this fell to 3 percent, and today Brazil has practically achieved universal basic education." (Naím, 2009) Reforms have been adopted, such as social security and tax systems, to improve the economy. Also, because of

the reforms, the Law of Fiscal Responsibility was established in order to oversee and control the executive branches at federal, state and municipal levels' spending. This helped in making Brazil's economy one of the fastest growing in the world with annual GDP growth rate above 7 percent in 2010 (Central Intelligence Agency, 2011).

Brazil's economy in the past has led to similar problems in fire departments where the lack of resources results in a lack of a sufficient budget, old or outdated equipment; and staffing, recruiting, and retaining members. However, it is clear that the economy and resources are growing. Brazil is still a third-world country, even with its increasingly first-world economy (Lyons, Latin America, 2011); an economy that should be able to support more comprehensive health and safety regulations.

4.1.2.4 Enforcement

In the United Kingdom approved inspectors will provide the building control service and check to make sure buildings in their area, and all work done in them, comply with the applicable regulations. According to "How the Building Regulations are enforced and your right to appeal" by Thomson Reuters, building regulations "can be broken by not following the building control procedures set out for handling your building work. They can also be broken by carrying out building work which does not comply with the technical requirements contained in the Building Regulations." (Reuters, 2011) If a regulation is broken, the inspector will notify the local authority. Then the individual who is responsible is fined and will receive a smaller fine every day after until the building is up to code.

In the favelas, building codes are not strictly enforced. This creates very dangerous situations. In the case of a disaster, like the floods in January 2011, the consequences are catastrophic. "Past attempts in Brazil to enforce building codes in favelas have not gone so smoothly. But since the January floods killed at least 900 people and left another 400 missing, the government and the public are coming to terms with the importance of urban planning." (Barnes, 2011) Public awareness to the issue of safety has made enforcing regulations significantly easier for the officials in charge of inspecting and ensuring that all buildings comply with established regulations.

4.1.2.5 Education

Education is a major factor in reducing the number and severity of fire-related accidents. Public fire safety education is important in making the general public aware of fire risks and measures they can take to prevent fire-related accidents. Then adequate training for firefighters is essential in creating a coherent, efficient, and effective fire fighting force.

Brazil does attempt to provide some education to the public on fire safety and what to do if in the event of a fire. On the Corpo de Bombeiros Militar website, on the "Frequently Asked Questions" page, "Notice of Fire or Accident and its confirmation" and "Tips for the Prevention of Accidents" pages provide valuable instructions how to accurately and efficiently report an incident and how to prevent an accident , respectively. For example when calling the fire department to state your name, phone number, whether or not there are victims, and calmly explain; the local fire or accident, actual situation of the fire or accident, and the risk of explosions. (Corpo de Bombeiros Militar, 2007) See Appendix for the complete list of instructions and tips.

However the country of Singapore has taken public education a step further by creating free applications for public to interact with. There are a number of applications for mobile devices, and games for children on the SCDF website, that are educational in preventing, and reacting to fires.

The improvement of education in Brazil is a big step towards more graduates in the field of fire protection as well as a greater research effort coordinated amongst universities, and is evidence of resources being allocated to upgrade the quality of life of the public.

According to Tavares "[t]he predominate activity in fire research in Brazil is concerned with structural fire resistance (primarily the analysis of concrete failure under elevated temperatures …) explosion research and fire risk analysis," (Tavares, 2009, p. 3). This research is primarily aimed at industrial applications, and not the protection of the occupants of buildings. This is partly because, in 2001, only twenty masters' degrees and

five doctorates were granted to students in the entire nation of Brazil in subjects related to fire safety (Ono, 2005, p. 117).

In 2005, Rosario Ono, Professor at the University of São Paulo, documented 26 research groups related to fire safety (Ono, 2005, p. 118). Of these groups, eight were focused on the behavior of structures including wood and steel, five groups conducted research regarding general matters of fire safety, and only three groups conducted fire modeling. However it is not just the small number of research groups that is of concern, but the lack of organization and communication between them. According to Ono, the six research groups located at the University of São Paulo were not communicating, nor knew of each other's existence. This lack of communication demonstrates the need for an organized fire research data collection to be used as a resource for all researchers of the subject.

Akin to the lack of communication between research organizations inside of the University of São Paulo, the university itself has little academic connections with researchers and scholars from other countries (Ono, 2005). These connections were not made due to of a lack of interest in international agreements and exchange of information. Creating academic information exchanges with universities with more advanced fire safety research programs could help the University of São Paulo to improve their own programs and increase their practical research output.

Also contributing to the fire problem is the lack of properly trained fire brigades in poor areas. According to the Keep the World Foundation, which aims to minimize extreme poverty in Brazil and has many other international projects, "The Brazilian fire service is limited to the large centres and is not sufficiently equipped for the most part. 95% of the more than 5,400 Brazilian administrative districts and cities don't have any fire brigade." Without fire brigades in a close proximity to the favelas, response times greatly increase, improving a fires chance of engulfing more homes. Similar issues have been documented in rural areas, which much like the favelas, do not receive enough state fire and rescue services.

For example, Adam Kubiske cites the example of forest fires in the Xingu region in his article Brazil's Indigenous Fire Brigade Completes Training. The growing number of forest fires is too much for the state fire brigades and "[t]he producers of the region have no one to ask for help in case of fires, especially criminal fires." (Kubiske, 2010) So a new volunteer based fire brigade was created and trained in this region. The Mato Grosso state fire department established a firefighting training program sponsored by USAID, the U.S. Forest Service, and with help from the NGO Aliança da Terra. This firefighting training program was specifically designed for the Xingu region, addressing the major fire related problems in that area.

In another effort to limit fires in the area, farmers were educated on alternate and modern techniques which reduce the risk of fire, and necessity to use fire as a method of clearing land. Within one year of creating a trained fire brigade and educating the public, there was a reported 80 percent drop in the number of fires in the Xingu region.

4.1.3 Urban and Natural Environment

The urban and natural environment of a country affects the fire brigades in many different ways. Climate has a direct effect on the number and type of fires present, as well as when the fire risk is greater than normal. Environment also encompasses the structural layout of cities and towns, and the natural hazards present there. It is important to analyze how the environment of Brazil affects the fire problem to determine the effectiveness of a reporting system, and other alternate solutions to improve the fire problem as a whole.

4.1.3.1 Geography and Climate

Brazil is located along the East coast of South America, covering a total area of 8,514,877 km^2, making it the fifth largest country in the world. To the North, lie the tropical jungles of the Amazon, and to the south, the cerrado, or Brazilian savanna. The extreme size of Brazil, and the varying climates within, makes monitoring the fire situation a difficult problem. There are many different types of fire, natural, wild, and structural, which has many types of its own, that must be investigated and processed by the fire brigades.

4.1.3.2 Urban Environment

While the favelas of Rio and São Paulo garner most of the attention from the press, much of the cities are well developed and increasing in property value (Lyons, Dark Side of Brazil's Rise, 2011). Apartment prices in Rio de Janeiro have doubled in the past 4 years, and office space in São Paulo is more expensive then in Manhattan. Spatially, favelas consist of a small percentage of land in Rio de Janeiro. Locations of these favelas are shown in Figure 3, along with urbanized zones. This figure was created by IPLAN-Rio using aerial photographs.

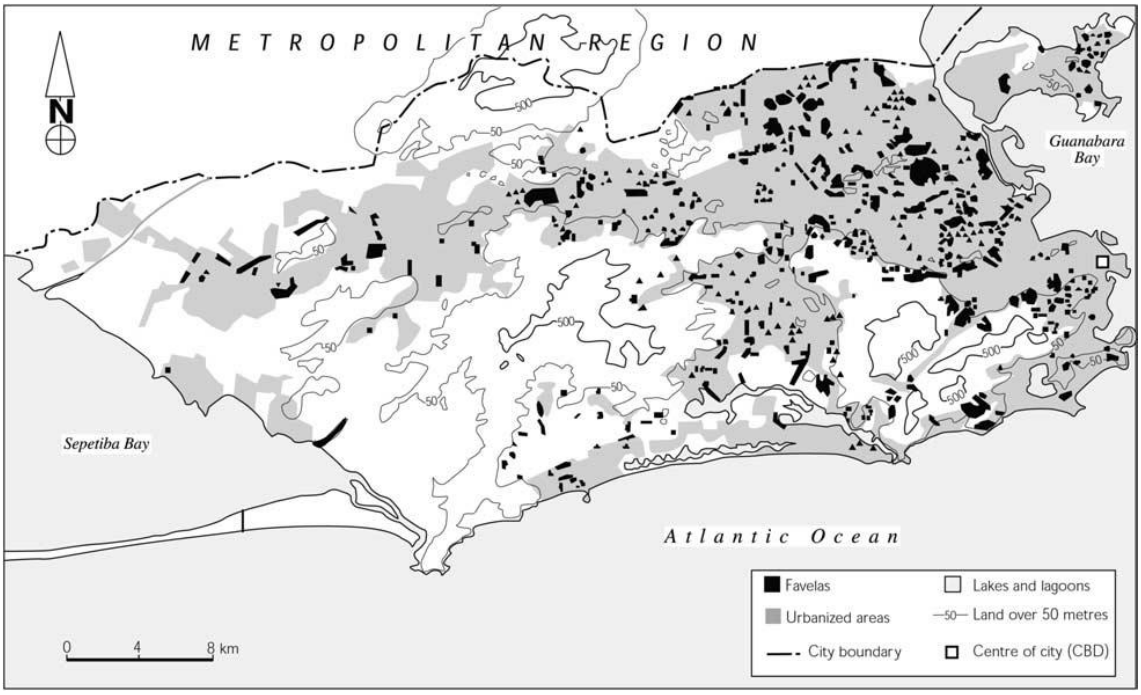

Figure 3: Distribution of land in Rio de Janeiro

According to *A Temporal and Spatial Analysis,* favelas are actively moving outwards, away from the city centers. The survey conducted by Pedro Jacobi showed the distribution of favelas in São Paulo to be .78% in the city center, 47% in the intermediate belt, and 52.2% in the suburban belt. This trend indicates that favelas are decreasing in density, which may be beneficial to the fire brigades in combating fires there; however moving to the outskirts of the city could also lead to poorer infrastructures and resources.

It has also been shown that the number of favelas in Brazilian cities is increasing at a rapid rate. Figure 1 and Figure 2, located on page 9, shows the rate at which the number of favelas in Rio de Janeiro was increasing in 1996. This is a major issue because past attempts made by the Brazilian government to eradicate favelas, conceal them in a "policy vacuum," and to improve them have been historically unsuccessful (Pamuk & Cavallieri, 1998).

In an attempt to help the low income residents of favelas, the Brazilian government began a program to relocate them to housing that would be in their financial budget, and to destroy the favela in order to create improved land. The problem with this plan was that the housing was located in low cost areas that were far from the center of the city and access to services, shopping facilities, and transportation was seldom available. In response, many of the residents who were relocated became upset and moved back to the favelas that were located closer to the center of the city. The government recognized what was happening and gradually came to realize that the way to help the favelas would be to enhance the existing informal settlements. (Aulicino, Abiko, & Andrade)

Improving favelas has proven to be a costly solution; for example, the main housing program, Favela Bairro, announced in the 1993 Housing Act, estimated that the average expenditure would be approximately US$2,500 per household to produce satisfactory improvements, with a maximum of US$4,000 (Iplan-Rio, 1999). However, in many cases these estimates were considerably low. The Serrinha favela, located on a steep slope required foundation stabilization, which increased the cost to US$3,937 per resident. When the cost is then multiplied by the average number of persons per household, 3.9 (IPLANRIO, 1997), it becomes US$15,494 per household.

The favelas of both Rio de Janeiro and São Paulo are difficult areas to combat fires for brigades. There are many reasons for this, including: unpaved roads, inadequate water supplies, and population and structure density. Obviously unpaved roads and the heavy traffic that can build up on them are a difficulty for large fire engines to maneuver. Adding to this difficulty is the slopped terrain that favelas are often located upon. Inadequate water supplies means fire brigades may have to locate other sources of pressurized water, such as

the engines themselves, to extinguish the flames. This could require more trucks in already congested and poorly maintained roads.

Clearly favelas are a real issue when considering the fire problem of Brazil. They are difficult to fight fires in, and are poorly constructed with little regard for safety and fire regulations. There density creates many opportunities for fires to spread to other structures. The issues of favelas are not a simple one to solve either, as shows by the three failed approaches the government has taken to eradicate and improve them. However it is unlikely that Brazil will be able to maintain an acceptable standard of fire protection for the public while they litter the landscape of its major cities.

4.1.4 Demography

Demography is the scientific study of human population, with reference to size, structure, and distribution. Specifically; population density, economic breakdown and wealth distribution, and education will be discusses in the context of Brazil. Demography will be used as one of the main examples of factors inhibiting Brazil from establishing an effective fire reporting system.

4.1.4.1 Population Density

The population density in Brazil varies greatly by State, as can be seen in Figure 4. Figure 5 shows the population densities in Brazil, with the darker brown being the densest areas and the white covering the least dense regions. It is clear to see that the population density is highest along the coast of Brazil. Areas of a higher density have different problems, due to the high population density, than areas of a low population density. The example of emergency vehicles is most relevant.

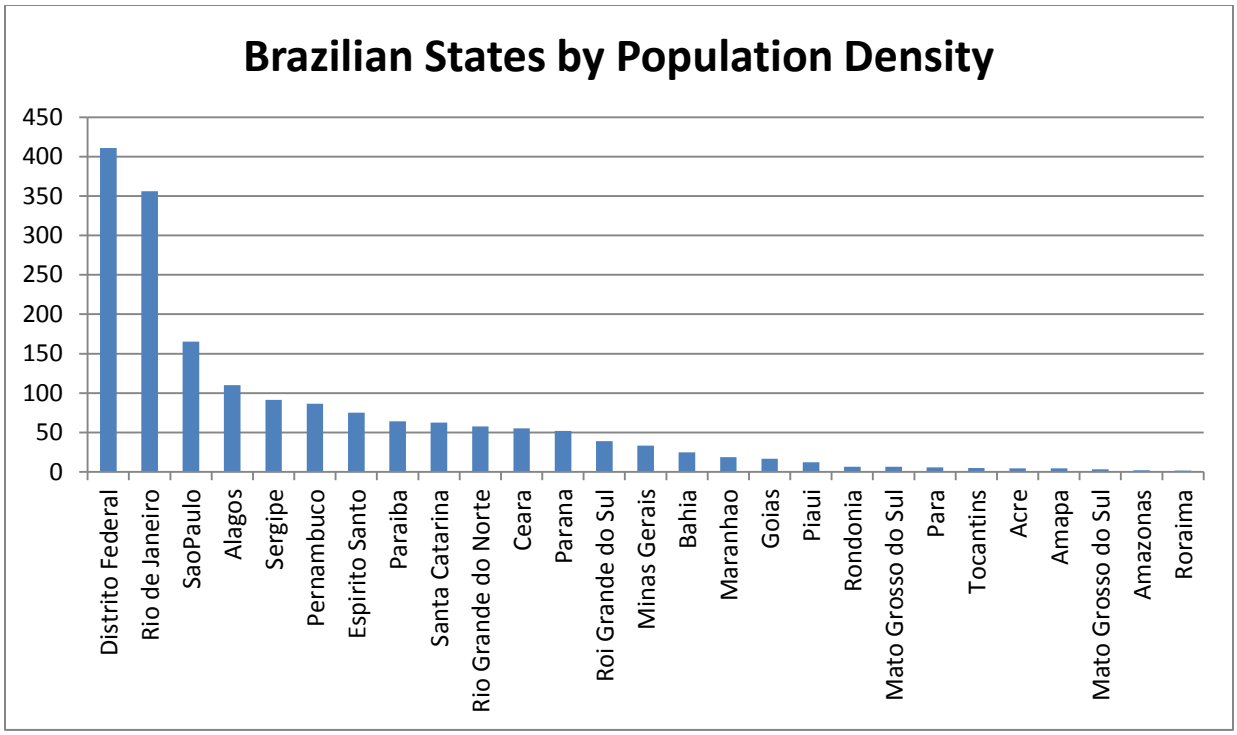

Figure 4: Brazilian States by Population

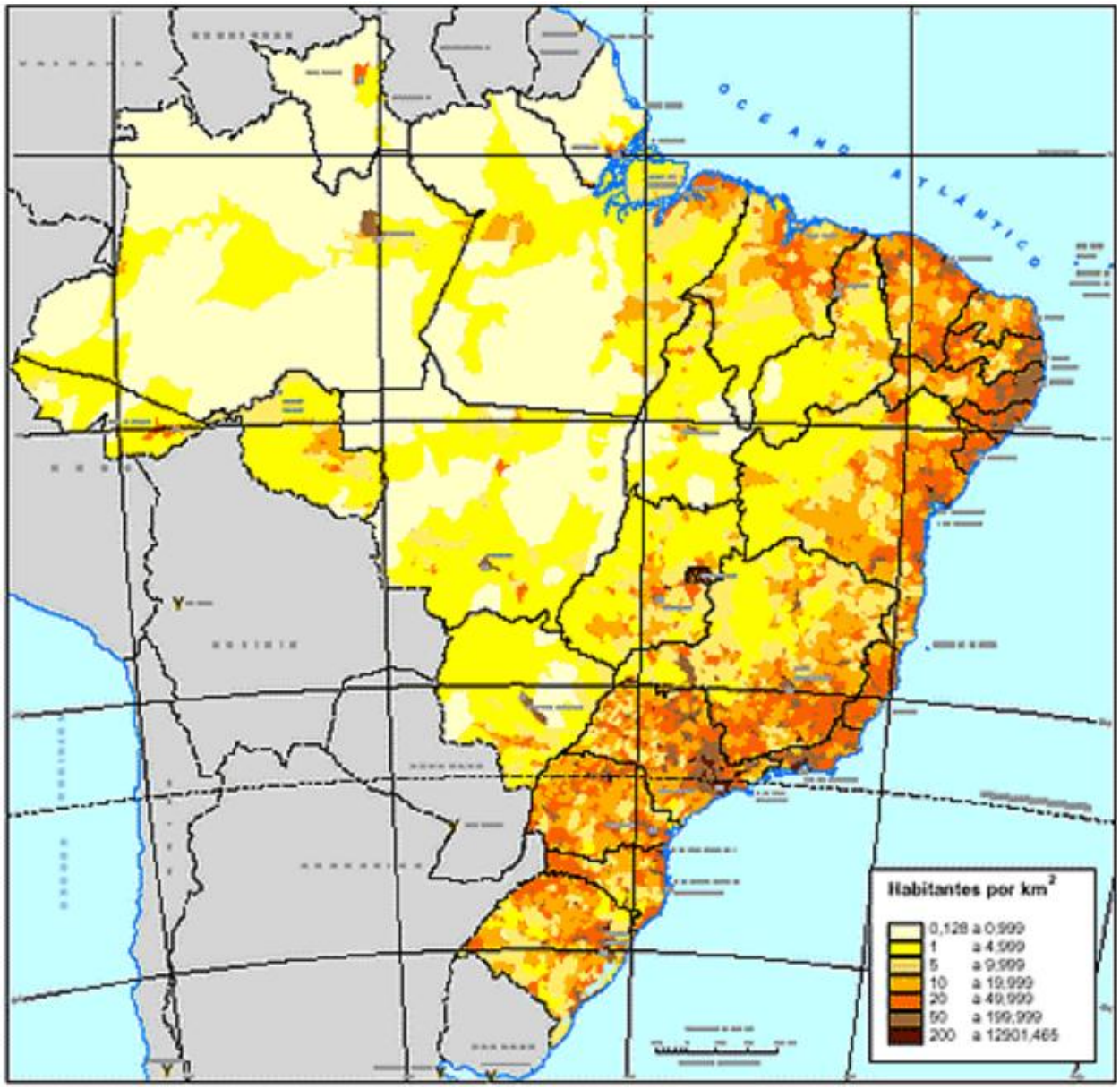

Figure 5: Brazil Population Density

In states such as the Distrito Federal, Rio de Janeiro, and São Paulo; there is a much higher population density than any other state. Brazil's fire service, generally, has difficulty in these cities because of how dense they are. Maneuvering vehicles through cites to get to the fire-related incident can be a challenge, especially in the favelas, resulting in poor performance by the fire and rescue services. Since areas of higher population density and areas of lower population density experience greatly varying issues, dense cities will be the

main focus in this report. The effect of high population densities will be examined and potential solutions to their fire-related incident problems will be investigated.

4.1.4.2 Economic Breakdown and Wealth Distribution

IPEA, the Research Institute Applied Economics, publishes in "Social Radar – Major Initiatives of the Federal Government" and has discussed the living conditions in Brazil. According to the second edition of "Social Radar – Major Initiatives of the Federal Government", in 2004, 19.8 million people, 11.3% of the population, were extremely poor and 52.5 million people, 30.1% of the population, were poor. Extremely poor was described as living with a monthly family income per capita up to ¼ minimum wage and poor was described as living with a monthly family income per capita up to ½ minimum wage. (Department of Planning of Social Programs Analysts, 2006)

Brazil's wealth distribution is shown in Figure 6Figure 3. The higher income levels are the darker shades of blue, approximately 236 US dollars. The lowest medium income, and therefore lightest shade of blue shown, was found to be approximately 53 US dollars. The darker, higher medium income, regions depicted in the center of the country are from the agricultural regions where a high general income is produced even with the low distribution of wealth. (Garbelotti)

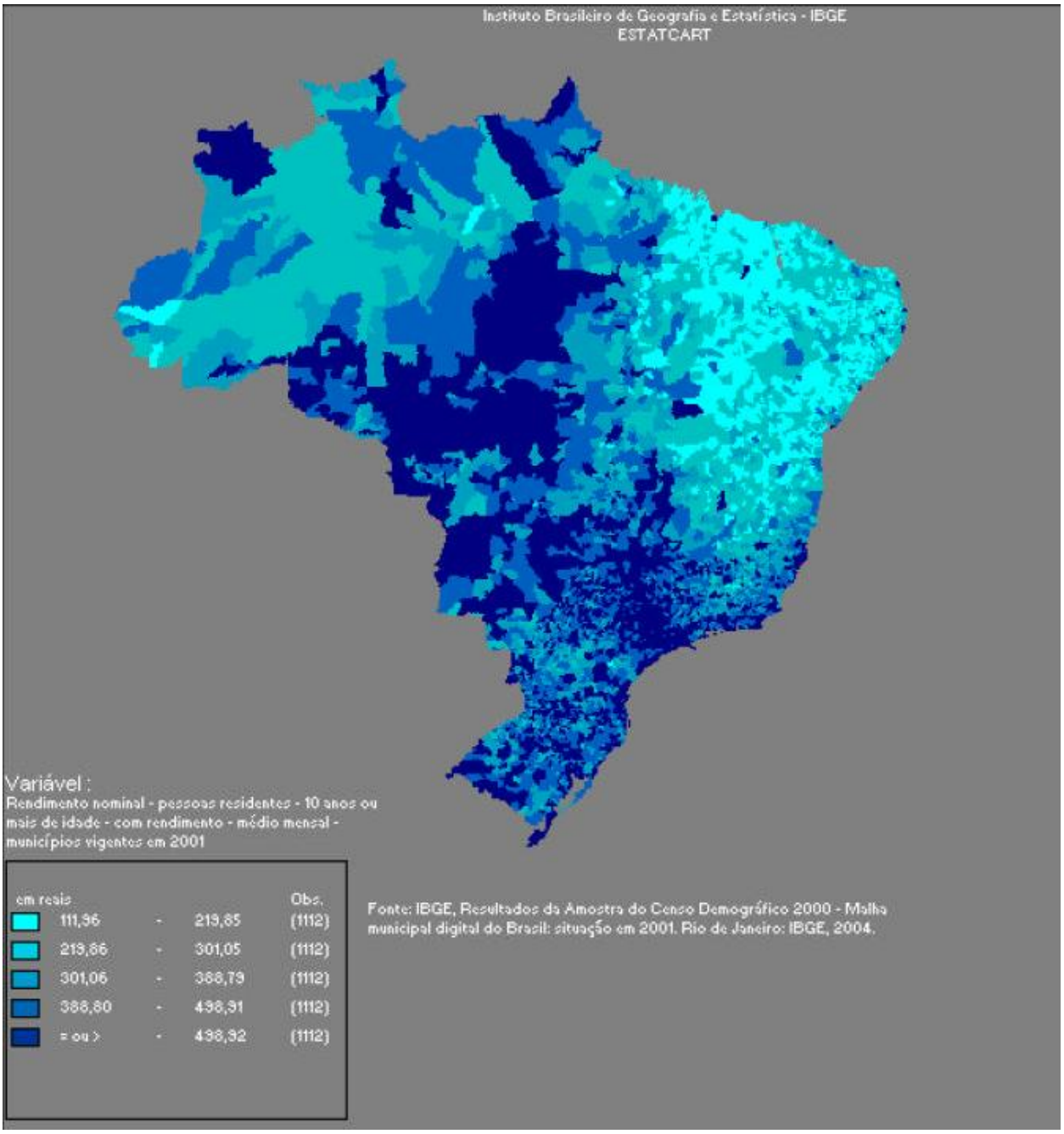

Figure 6: Brazil Income Distribution

"An Overview of the Strategy of Income Distribution in Brazil" is a report, written by Marco Andre de Oliveira Pedro Garbelotti, discussing; poverty in Brazil, the strategy of intervention on poverty, merging the programs of income transference, and the role of growth with poverty reduction. "The distribution of income in the society is correlated to the possession of the production factors and the price its owners get in the market.

Obviously, factors like the personal abilities and the transmission of goods through inheritance contribute to an unequal distribution of wealth. However, the improvement of some people is made upon the expenses of others." (Garbelotti)

The Gini Index measures income inequality in a way to easy compare countries. This method compares countries with a number that represents the ratio of the income between the top 20% of the population to the income of the poorest 20% of the population. Some examples include:

- South Asia = 4
- East Asia = 6
- Middle East = 6
- North Africa = 6
- Sub-Saharan Africa = 10
- Latin America = 12
- Brazil = 30

Brazil has a significantly higher difference in income from the top 20% to the poorest 20%. This is noticeable in Figure 6 where there are large portions of dark blue and large portions of light blue but not a lot of shades in between. "The problem of inequality is very serious in Brazil, where the distribution of wealth is one of the worst in the world as a whole and where there is at least 12.9% of the population living in extreme poverty. (Velloso & Albuquerque, 2004) However; the income distribution has improved since 1993 and consistently from 2003. The main reason for this improvement in income distribution is the reduction of poverty, besides the fact that some decrease in the income of the richest people was observed. Among the main reason for this reduction lays in the decrease in food prices, improvements in scholarships and mainly the advances in social programs, social welfare incomes and a real increase in the minimum wage." (Soares, 2005)

4.1.4.3 Education

Education is a major factor in reducing the number and severity of fire-related accidents. Not only is public fire safety education important in making the general public aware of fire risks and measures they can take to prevent fire-related accidents and adequate training for firefighters necessary, but general education of the public is essential

in improving the fire problem in Brazil. The improvement of education in Brazil is a big step towards more graduates in the field of fire protection and is evidence of resources being allocated to upgrade the quality of life of the public.

A large part of the education problem in Brazil is a result of intergenerational transmission of poverty. Intergenerational transmission of poverty is an issue to focus on because under the assumptions that an important factor in ending intergenerational poverty transmission is education and the relationship between child labor and a lifetime of poverty, in most cases parents in poverty will be driven to send their children to work in order to generate more income for the family. This results in less educated children which keeps the family in poverty. (Baland & Robinson, 2000)

4.2 United States

Unlike the discussion on Brazil above, this section, and subsequent sections, focus on fire department information, fire incident reporting systems and how the data are used to help address the fire problem in developed countries. In 2010 it was documented that there were 1,103,300 firefighters in the United States, distributed between 30,125 fire departments which are housed in 51,300 fire stations. Of these 1,103,300 firefighters 30% (335,150) were career firefighters and 70% (768,150) were volunteer firefighters. (National Fire Protection Association , 2012) The majority of the career firefighters, 73%, were located in populations that contained 25,000 or more individuals to protect. Conversely 95% of the volunteer firefighters work in departments that protect communities of less than 25,000 individuals. More than half of these volunteer firefighters respond to calls in communities that are made up of less than 2,500 people.

When a fire department is alerted to respond to an emergency situation they have the additional job of filling out the emergency an incident report. Departments may have different forms and ways of gathering information, but in the US it is recommended that the departments fill out and submit the form for the National Fire Incident Reporting System (NFIRS).

4.2.1 Collected Data

The basic fire incident report, used to collect data from each call and pass to the NFIRS system, contains a variety of information. The first segment of the report, lines A through I, are completed by an officer for all incidents the fire department responds to. This segment holds; the incident number, the date, the day of the week, the alarm time, the arrival time, the time in service, the type of situation found, and the type of action taken during the incident (National Fire Protection Association, 2004). Each incident is given a unique and typically sequential number. This number will be found on all reports on the incident which come together to form an official record for each incident (National Fire Protection Association, 2011). The second segment of the basic fire incident report, lines J through M, is completed on all incidents which are fires. The information reported in this section consists of; the type of complex, the mobile property type, the area of the fire origin,

the equipment involved in the ignition of the fire, the form of the heat of ignition, the dollar loss of the damage, and more. This information is pertinent and used to study the spread of the fire. This is especially important in cases when an investigator is called in because the fire is suspicious and could possibly be an act of arson. The third segment of the basic fire incident report, lines N through R, is completed when the incident is a structure fire. The information included in this section is; the number of stories of the structure, the type of construction, the extent of the flame damage, the detector performance, the sprinkler performance, the type of material generating the most smoke, the avenue of smoke travel, and the form of the material generating the most smoke. The fourth segment of the basic fire incident report, lines S and T deal with whether there was mobile property or other equipment involved in the fire (National Fire Protection Association, 2004). Information about where the mobile property or equipment was located is recorded, along with the damage that the property took.

Civilian and firefighter casualty forms are collected along with the basic fire incident reports and placed in the incident record if a casualty or injury occurs. The civilian casualty forms have areas to record three casualties on each form. The information collected includes; the incident number, the date, the day of the week, the alarm time, the casualty name, the casualty age, the time of the injury, the gender of the person injured, the severity of the injury, the familiarity with the structure, the location at ignition, and the condition before the injury (National Fire Protection Association, 2004). The familiarity of the person with the structure can be important to see and collect data on how the individual reacted in the emergency situation, knowing the location of the individual at the ignition of the fire also helps in this sense.

The firefighter casualty forms are completed every time a firefighter is injured. The information collected includes; the firefighter's age, the severity of the injury, the part of the body that was injured, the firefighter's activity prior to the injury, the cause of the injury, and the medical care that was provided to the firefighter. There is also a section on the firefighter casualty form that collects information on the condition of the firefighter's personal protective equipment. The personal protective equipment, PPE, of a firefighter includes; their coat, trousers, boots or shoes, helmet, face protection or shield, breathing

apparatus, and their gloves (National Fire Protection Association, 2004). Data is collected on the condition of the PPE to see the relationship between the extent of the firefighter's injuries and the damage done to the equipment.

4.2.2 Uses of NFIRS

There are many groups and individuals that access the NFIRS database and use the collected information in a variety of ways. The three main ways to use the analysis of NFIRS data are; to gain insights into the fire problems of an area, to improve resource allocation for combating fires, and to identify training needs (National Fire Protection Association, 2004). These ways of using the information are the basis of all uses of NFIRS data. Federal, State, and Local governments and organizations use the NFIRS data. In the state of Massachusetts NFIRS data was used to create a new law that reduced the number of cases of vehicle fire arson in the state (National Fire Protection Association , 2012). NFIRS data can also be used to identify trends in the number of incidents, the types of incidents, and the origin of incidents. This information often used in the justification of budgets and also when looking at the allocation and relocation of fire department resources, whether it be the number of firefighters on a shift or the location of a new fire station. NFIRS data is also commonly used when a fire protection professional is called on to give a congressional or court testimony.

There are also times when media outlets will contact the National Fire Data Center for information to use in background stories. One of the largest uses of the NFIRS data is by educators from academic institutions, research institutions, and educators of the public (National Fire Protection Association , 2012). These groups use the data to identify specifics of fire safety that need to be improved upon.

Public educators may use this specific information to come up with new public safety programs to take into the schools and workplaces in a community. On the other side of the same issues academic and research institutions may use the information to work with the pupils on ways to prevent the issues that are occurring.

4.2.3 Pros and Cons of NFIRS

The NFIRS system is the largest fire incident database in use. The system has been revamped multiple times with changes being made to make it more understandable for the individuals entering information into the system and also accessing and using information from the system. The only way that the system works is to have a uniform definition in coding across the nation for the information that is entered into the system (National Fire Protection Association , 2012). NFPA 901 was created to help with this. It presents a common language for the; pre-incident data collection, fire and emergency data, and the post incident data collection. It also defines the numeric classifications of data elements that describe fire protection and fire service information. But the biggest thing that NFPA 901 does not do is to give guidelines for the reporting system or any forms related to the system (National Fire Protection Association, 2011).

The United States Fire Administration and the national government do not mandate that fire departments across the United States have to use enter fire data into the NFIRS system. In 1977 only five states had fire departments entering data into the system. By June of 1997 14,000 of the 30,000 fire departments across the nation were entering data. These departments came from forty-one of the fifty states in the nation (National Fire Protection Association, 2011). As of 2008, 22,494 of the 30,165 fire departments across the nation were entering data into the NFIRS system. The departments came from all fifty of the United States of America (US Fire Administration , 2011). Since not all of the fire departments enter data into the NFIRS system, and not all of the departments that do enter all of their annual data we cannot have a complete picture of the fire problem in the United States.

Another nuisance is that the data gathered in each incident varies. This is because not all of the data asked for is relevant in every situation, but also because each individual who collects data interprets and reports it differently (National Fire Protection Association , 2012). Fire departments without the correct software to collect the NFIRS data and enter it into the system themselves send copies of their written reports to the State Fire Marshal's office where the data is then entered into a system and sent on to the Federal

Emergency Management Agency in Washington D.C. One big improvement to the NFIRS system is the addition of data quality procedures. The procedures would include checking all of the information on the forms and verifying that the correct codes are being used (National Fire Protection Association, 2004).

4.3 Finland

Finland has an estimated land area of about 300,000 km^2 and an average population density of 17 inhabitants / km^2. However, in the Greater Helsinki Region (Helsinki, Espoo, Vantaa, Kauniainen, Kirkkummi, and Siuntio) the population density is approximately 46 times the national average at 705 inhabitants / km^2. Almost 20 percent of 5,206,000 inhabitants reside in less than 0.5 percent of the country. (Ministry of the Interior Department for Rescue Services)

The Ministry of the Interior regulates firefighting in Finland but each municipality independently decides how to staff their fire and rescue services. They can choose to provide a professional fire brigade, a half-ordinary fire brigade, or a voluntary fire brigade. While the Ministry of the Interior monitors the twenty-two rescue service regions in Finland, each region is responsible for the rescue services in their region. Some of the responsibilities these rescue services include; accident prevention, damage mitigation and fire inspections, safety education and advise, rescue operations, and civil defense.

Finland has about 5,000 full-time employees in the professional fire and rescue service. All professional firefighters are trained at either Emergency Services Collage or City of Helsinki rescue school. There are many volunteer firefighters, estimated at over 15,000 firefighters in over 600 brigades. There are about 400 municipalities in which the fire brigades are comprised entirely of volunteer fire brigades. These municipalities encompass 95% of the country's area and 47% of the country's population. There are two types of volunteer fire brigades; voluntary fire brigades, and half-ordinary fire brigades. The only difference between the two is that, with half-ordinary fire brigades, firefighters have a contract but they are not professional firefighters.

The advantage of letting each municipality independently decide on how to structure their fire and rescue services is that they can be specifically designed to provide the necessary service most effectively and efficiently for each region. They individually decide what tasks the fire and rescue services will handle in each municipality held within the region. According to the Ministry of the Interior Department for Rescue Services' website, the basic duties that the rescue services are responsible for in each region are:

- Providing education and advice regarding rescue service to the public
- Acting as experts in matters concerning rescue services
- Preventing accidents, mitigating damage and carrying out fire inspections
- Civil defense
- Coordinating activities of different authorities and other parties in the field of rescue services
- Providing training for rescue service personnel

Brazil's also has independently run municipality specific fire and rescue services, with professional and volunteer firefighters. Since Brazil's fire and rescue services are organized very similarly to Finland's, implementing certain features of Finland's fire and rescue service procedures or aspects of Finland's fire-related incident reporting system could be possible. This could significantly improve the efficiency and effectiveness of Brazil's fire and rescue service and fire-related incident reporting system.

There are three main functions of the rescue services in Finland; accident prevention, rescue operations, and civil defense. Accident prevention is carried out by working with and educating authorities, organizations, and the citizens. Rescue operations must be efficient and effective at protecting and rescuing people, property, and the environment. Civil defense is their ability to function in an emergency situation.

Finland's fire and rescue services specify standards for fire safety of buildings in an active effort of accident and fire prevention. It is the responsibility of the building owners and occupants to do their part in keeping themselves and those around them safe by following the guidelines established. "Buildings and their surroundings must be designed, built and maintained so that the risk of fire occurring or spreading is minor and so that it will be possible to carry out rescue operations in the event of an accident. Building and dwelling owners and occupants are required to keep the equipment specified by the authorities in working order at all times. The signs indicating escape routes and exits, security labels and the supplies in civil defense shelters must be operational and

appropriately serviced and inspected. Fireplaces and flues must be swept, and ventilation ducts and devices must be serviced and cleaned regularly." (Ministry of the Interior Department for Rescue Services)

The Ministry of the Interior Department for Rescue Services also requires each individual to be prepared in case of an emergency and is responsible for installing a smoke alarm for each 60 m^2 of their home. Fire safety and advice is provided by the regional rescue services and fire inspections are conducted regularly to ensure compliance with regulations.

The second main function of the fire and rescue service is rescue operation; this is their response to an accident or threat. They aim to operate efficiently in responding to incidents and providing the necessary services. Rescue operations and responsibilities include:

- Receiving emergency calls
- Alerting rescue units and other help
- Warning the population
- Preventing impending accidents
- Protecting people, property and the environment at risk
- Firefighting, and preventing and limiting other damage
- Damping down, clearing and security, along with related command, communications, maintenance and other support functions (Ministry of the Interior Department for Rescue Services)

As part of the responsibilities of the rescue operations function of the fire and rescue service, at the national level, is alerting the public in the event of an emergency that is of risk to human lives or substantial property or environmental damage. A warning signal will be broadcast over radio and free TV channels nationwide. While there are

opportunities for the public to acquire information regarding the proper response to the warning signals, all radio and television stations broadcast instructions during the alert.

One of the Ministry of the Interior Department for Rescue Services' responsibilities is to steer the "…civil defense planning [the final responsibility of the Rescue Services]. The Department issues instructions to the authorities on civil defense preparedness and ensures the required collaboration…In normal conditions, civil defense preparedness includes:

- Planning and training regarding emergencies
- Building shelters
- Maintaining command, supervision and alarm systems, and communications links
- Making provision for evacuations, rescue operations, first aid, providing the population with the supplies required, and for accident clearance and cleaning." (Ministry of the Interior Department for Rescue Services)

Specialized training for the fire and rescue services is conducted at the Emergency Services College, in Kuopio, under the guidance of the Ministry of the Interior. A Fire Fighter Diploma from the Emergency Services College is required for a full-time position in the fire and rescue service. The prerequisites for admittance include a matriculation examination or a vocational qualification. While enrolled at the Emergency Services College, students will be instructed on preparedness in emergency situations and additional rescue services training. (Ministry of the Interior Department for Rescue Services)

The fire and rescue service has a fire-incident reporting system established, called PRONTO. It is an internet-based accident statistics system. Established in 1996, PRONTO is comprised of all fire-related incidents reported by municipality. By collecting and organizing fire-related incident data, the fire and rescue service can assess their performance and the performance of fire-safety regulations in place in order to determine areas that may need improvement.

An estimated EUR 340 million is spent on State and regional rescue services and EUR 39 million is spent by property owners on building civil defense shelters each year. (Ministry of the Interior Department for Rescue Services) But some assistance is provided from the Finnish Fire Protection Fund. EUR 9 million can be used for any projects relating to fire prevention or the promotion of the rescue service. “The Fire Protection Fund grants assistance to such as rescue service organizations, municipalities and rescue service regions. The most essential targets have included training activities of rescue service organizations and national information campaigns, research projects that support rescue services, procurement of rescue service vehicles and building fire stations.” (Ministry of the Interior Department for Rescue Services)

4.4 Singapore

Singapore is located in Southeast Asia, off the southern tip of the Malay Peninsula. The city-state is highly urbanized, with only half the land being covered by greenery. The government of Singapore is a parliamentary republic with a legal system based on English common law. However there are some stark differences which, in part, lead to Singapore's declaration as a "hybrid regime" by *The Economist* (The Economist, 2010). For example, in 1970, "trial by Jury" was entirely abolished, leaving the responsibility to judgeship. Even with the substantial power held by the government and its officials, Singapore was rated the 3rd least corrupt nation in the world by Transparency International (Transparency International, 2009).

Singapore and Brazil are very different countries geographically, biographically, and economically. While Singapore, like parts of Brazil, is a tropical environment, their distance from one another as well as their landmass, are stark differences. According to the Central Intelligence Agency's World Fact book, the Republic of Singapore's landmass is roughly 679 km^2, while Brazil's is 8,514,877 km^2; the population of Singapore is roughly 4.7 million the population of Brazil is over 203 million; and the gross domestic product per capita is $59,900 (2011 US dollars) in Singapore and $11,600 in Brazil (Central Intelligence Agency, 2011).

We chose to analyze the fire reporting system in the country of Singapore because of its efficiency at collecting and organizing information that allows officials to understand what specific issues their country faces in regards to fire, and where these issues are most abundant. This information is then presented to the public in order to educate them and increase their awareness of risk. These reasons will be discussed in depth after a general description of the Singapore Civil Defense Force, which utilizes them.

The fire department in Singapore is known as the Singapore Civil Defense Force, whose responsibilities include fire-fighting, rescue and emergency ambulance services, mitigating hazardous materials incidents, and formulating, implementing, and enforcing regulations on fire safety and civil defense shelter matters.

The organization of the SCDF is a three-tier command structure spear-headed by the HQ, which consists of staff departments such as Logistics, Training, Fire Safety & Shelter, and Enforcement. A complete list of the departments can be found in Appendix I. The HQ is the "plans and policy-making unit within the SCDF," organizing the goals and values of the force, as well as creating policies that direct the force in strategic directions. The HQ is also responsible for maintaining internal affairs, with an audit system designed to ensure that all sub-units operate under prescribed Force standards. Finally, operated by the HQ is the customer-service center, which handles a range of services from processing ambulance fees to the consultation of fire safety in buildings.

The second tier of the command structure is the Civil Defense Divisions; 4 in all which divide the city-state into South, East, North, and West. These divisions have many of the same supporting elements as the HQ SCDF, which are directed at organizing their specific stations and "men on the ground." These Divisions control 6, 3, 3, and 4 stations respectively, as well as fire posts and training facilities.

The third and final tier of the SCDF is the men and women in each fire station, fire post, and training facility. While these members of the SCDF do not make organizational decisions, it is their investigations of fire incidents and the reports of their findings that lead to understanding the fire situation of Singapore.

One major outcome of understanding what fire issues are present has led to the SCDF's development of custom vehicles designed to tackle these issues. The specially designed vehicles for fire incidents are the:

- Fire Bike
- Light Fire Attack Vehicle (LFAV aka Red Rhino)
- Rapid Mitigation Vehicle (RMV)
- Pump-Ladder (PL)
- Combined Platform-Ladder (CPL)
- Aerial Ladder (AL)

- Tracked Firefighting Vehicle (TFV)

With these eight different types of vehicles the most common and major fire scenarios are covered. For example, the fire bike tackles small fires or is the first responder waiting for back up from the red Rhino. The Red Rhino is capable of working in the densely built up areas of Singapore, places where a Pump-Ladder wouldn't fit. To combat forest fires the tracked TFV is necessary because of the difficulty of getting wheeled vehicles to the incident.

These eight specialized vehicles are examples of the benefits of a fire reporting system. A problem was identified, such as unacceptable response times, and a solution was created; in this case a motorcycle that can pass through traffic more easily than a full sized fire truck. This also allows the occupant of the fire bike to assess the fire situation present and inform backup where and how to setup equipment to most efficiently combat the fire.

Another outcome of the effectiveness of Singapore's fire reporting system is the development of new fire stations and fire posts. The first Civil Defense Division is currently organizing a new station in the Marina Bay, a location that has seen an increase in construction and population density, so as to avoid outreaching the other stations.

Finally, knowing what other hazards are located near or in locations during a fire helps the fire fighting forces decide what equipment is necessary to combat the fire. Fire stations near industrial sectors, or construction areas (as well as others) contain HAZMAT equipment in case of chemical agents involved in the fire. Vehicles stored at each station are also organized by what types of fires the station often deals with to ensure the proper equipment is available in emergency situations.

4.5 United Kingdom

In the United Kingdom, the fire service provided to the country is the solely the responsibility of the national government. Starting in 1941, all UK fire service was under the National Fire Service. Since the adoption of the National Fire Service each country; England, Scotland, Ireland, and Wales, has established its own country-specific governing body under the National Fire Service; the Office of the Deputy Prime Minister (ODPM), Her Majesty's Fire Inspectorate for Scotland (HMFSI), Northern Ireland Assembly, and the Welsh Assembly, respectively. Fire brigades are then organized under the government by command, area, division, and borough. Large brigades can be divided into commands and/or broken up into areas by geographical area i.e. north, south, east, and west. Also, brigade presiding over small geographical areas could, if they so choose, to be organized into divisions. Boroughs are small divisions and sometimes commands overlap with boroughs.

The United Kingdom Fire and Rescue Services provide their services for free in the case of an emergency. It's funded mainly from a central government grant and a levy on the local council tax. And the Fire and Rescue Services Act 2004, is an Act that explicitly explains the authorities and functions of the fire and rescue service in the United Kingdom. The powers of the Fire and Rescue Service in the case of an emergency, according to the Fire and Rescue Services Act 2004, section 44, are:

1. An employee of a fire and rescue authority who is authorized in writing by the authority for the purposes of this section may do anything he reasonably believes to be necessary—
    a. if he reasonably believes a fire to have broken out or to be about to break out, for the purpose of extinguishing or preventing the fire or protecting life or property;
    b. if he reasonably believes a road traffic accident to have occurred, for the purpose of rescuing people or protecting them from serious harm;

c. if he reasonably believes an emergency of another kind to have occurred, for the purpose of discharging any function conferred on the fire and rescue authority in relation to the emergency;

d. For the purpose of preventing or limiting damage to property resulting from action taken as mentioned in paragraph (a), (b) or (c).

2. In particular, an employee of a fire and rescue authority who is authorized as mentioned in subsection (1) may under that subsection—

   a. enter premises or a place, by force if necessary, without the consent of the owner or occupier of the premises or place;

   b. move or break into a vehicle without the consent of its owner;

   c. close a highway;

   d. stop and regulate traffic;

   e. Restrict the access of persons to premises or a place.

3. A person commits an offense if without reasonable excuse he obstructs or interferes with an employee of a fire and rescue authority taking action authorized under this section.

4. A person guilty of an offense under subsection (3) is liable on summary conviction to a fine not exceeding level 3 on the standard scale. (Fire and Rescue Services Act 2004, 2004)

4.5.1 Reporting System

In the United Kingdom, fire and rescue services report all fire-related incidents and provide data that can be analyzed or used in statistics. The Fire Statistics and Research (FSR) Division did a study on the collection of fire data (Finegan, Ball, & Southern, 2005). In

this study, the authors discuss their findings, which included the observation that the majority of data collected is paper-based and could use some improvements in efficiency and usefulness. In particular, they note that improvements could be made in content, design, complexity, timeliness, efficiency, quality, consistency, and availability.

The UK Fire Service reports all fire-related incidents using two forms, the Fire Data Report 1 (FDR1) and Fire Data Report 3 (FDR3). The Fire Data Report 2 (FDR2) form is used for amendments to the FDR1. All primary fires are reported on FDR1 when they happen and all secondary fires in a month are collected at one time on FDR3. The majority of FDR1 data is given the FSR data center in paper forms. This accounts for the delay in an annual report. Brigades collect the data for the month but the report typically arrives to ODPM several months after the date of data collection. Validation of the reports furthers the delay making it, in most cases, up to a year before an annual report is published.

Form FDR1 collects a vast selection of data for each reported incident unlike FDR3. Secondary fires, chimney fires and false alarms are reported with a very small selection of data. The data collected for FDR1 falls into the following categories; brigade information, incident information, location of fire, extinction of fire, supposed cause, damage and other fire details, life risk, and additional information.

One of the big problems with the current system is the inconvenience of having a reporting system where significant portions of the form have irrelevant sections in an attempt to have the convenience of being applied to any fire-related incident. In order to submit using electronic data interchange (EDI), the ODPM must accredit the brigade to guarantee proper use and accurate data entry. Receiving accreditation is a process often seen as a waste of time. Therefore, most of FDR1 data that has been reported came from a brigade that opted out of the suggested accreditation. This causes a possibility of a vastly different standard of quality data between brigades.

Another problem was the lack of firefighters' understanding of the importance of what they are supposed to be reporting. Unsatisfactory quality data is a result of the easier option is selected rather than an accurate representation of the fire-related incident that has transpired. The necessity of the data is not always clear to the brigades, leading to

missing or inaccurate incident reports. Proper classification of fires is a struggle for firefighters. That along with the difficult field codes sets up a situation perfect for incorrectly reporting the information, thereby skewing the statistics.

Table 4 was recreated from section 3.1 of the report. It shows who uses each of the fire-related incident reports and their purpose for looking at it.

Table 4: Collection and Analysis of Fire Data - The Current Position

Hierarchy of Reports	Normally Completed by	Typically Used by	Purpose	Additional or Subsequent use
FDR3	Fire and Rescue Service	ODPM	To compile National Statistics	To inform research and policy
		F&RS	To inform IRMPs and Community Safety Plans	
Local Performance	Fire and Rescue Service	Police, Local Safety Partnerships, Crime & Disorder Partnerships	Usually to identify local fire-raising activity and patterns	
FDR1	Fire and Rescue Service	ODPM	To compile National Statistics	To inform research and policy
		F&RS	To inform IRMPs and Community Safety Plans	
		Insurers	To inform response to policy claims	To inform insurance risk assessment
		Coroners	To inform the Court	To make recommendations
		Criminal Justice System	To inform the Court	
FDR2	Fire and Rescue Service	As FDR1	Amends FDR1	As FDR1
Fire Investigation Report	Fire and Rescue Service	As FDR1	As required by F&RS	As FDR1
Fire of Special Interest	Fire and Rescue Service	HM Fire Service Inspectorate	To monitor events which may have national implications for public or fire-fighter safety	To provide briefing for ministers
Scientific Investigation	Scenes of Crime Officer	Criminal Justice System	To inform the Court	
	Forensic Scientist	Criminal Justice System	To inform the Court	
		Insurers	To inform response to policy claims	To inform insurance risk assessment
	Building Research Establishment	ODPM	To inform building regulation	

The FSR, in this study, decided on a set of data collection and transfer requirements for use when handling fire-related incident data. The set of requirements includes;

- Enabling FRSs for all incidents to be captured and transferred electronically
- The ability to collect the necessary data for a new form that is in the process of being developed
- The ability to capture data in any combination of manual and automatic means and be viewed from a range of locations
- Disturb the current data collection method as minimally as possible
- Ensure that all tasks relating to the form are simplified as much as possible and highest efficiency
- Have the ability to update the incident form
- Ability export and retrieve data, and allow multiple users at one time while tracking the status of the form.

When searching for a smarter more efficient and effective system for reporting and compiling data collected at fire-related incidents, various methods were investigated. The six most feasible methods were determined to be; online web forms connecting to the central ODPM database, offline web forms collecting data locally for batch transfer to the ODPM, XML interface allowing the upload of incident data from existing FRS systems, a centralized call center completing forms for FRSs by telephone, an integrated management information system tightly coupled to existing FRS systems, and a hybrid solution providing three access channels through a single interface.

The hybrid solution has many strengths, for example, having the ability of allowing the transfer of data through one set of validation rules, making it very efficient. But implementing this system would be challenging. There are many risks involved in switching or modifying the system as shown in Table 5. This table assesses the risks and

impacts involved in switching to a new system. Then it gives the proposed mitigation for each of the possible situations given.

Table 5: Recreated from Chapter 7 Project Delivery. Key Strategic Risks

Risk	Impact	Proposed Mitigation
The current ODPM IS Strategy is undergoing review and change, impacting the decision-making environment, particularly with regard to the use of existing ODPM systems.	A clear direction as to the user or otherwise of systems such as LogasNet and Interform is difficult to establish.	FSRD are to continue to work closely with ODPM e-Business to establish the impact of the emerging strategy for data collection systems.
The impact of the ODPM Analytical Services Strategy, which is currently under development, is not yet known.	Policies and standards that emerge from the study may conflict with the approach to data management and analysis taken by the FSRD.	FSRD are to continue to maintain regular and open communication with the wider ODPM analytical services community.
The impact of ODPM's internal security accreditation process cannot be currently determined as it has not been completed.	The current hardware and infrastructure scope may be impacted significantly by the results of the accreditation process.	FSRD are to continue to work closely with ODPM Security to accredit plans for the system in a timely manner.
FRS co-operation and adoption may not be secured due to resource constraints or organizational tensions.	Use of the system may be inappropriate or piecemeal with resultant loss of benefit for both FRSs and ODPM.	An effective change management and communications strategy must be put in place to ensure the engagement of all key stakeholders.
Appropriate re-use of existing components such as Logasnet or Interform for the purposes of data collection may require significant time and effort, and creates a dependency for the future direction and progress of the system.	System implementation may be significantly delayed while planned developments for Interform and Logasnet materialize.	Open and frequent communication should be maintained with the e-Business, Logasnet, and Interform teams.

The Review of the National Fire and Rescue Incident Statistics Collection (Katalysis Limited, 2004) is the final report on a review on the current incident reporting system. It explains the reasons why a new system needs to be implemented. There were incident reporting requirement changes that are a large part of the reason why it was necessary to start developing a new system for reporting incidents. With the added requirements and the inconsistencies with paper and electronic reporting, fire-related incident reporting had become very cumbersome and prone to mistakes. Reviewing the process used for reviewing the current system of reporting fire-related incidents in the UK can prove useful for when making recommendations to Brazil on what type of fire reporting system should be implanted. The steps they took included a review of the current reporting practice, meetings with the Garston data unit and stakeholders in the ODPM, workshops to assess of the needs of the stakeholders, and testing the feasibility of the new incident reporting system in development.

In order to implement a new system there are some recommendations that should be considered; it is recommended that a particular set of data that satisfies the majority of the needs, brigades are in agreement on the necessary set of data to be shared between brigades involved in an incident that encompasses multiple jurisdictions, everything is clearly defined and understandable, there is a standard in place for validation, format and layout, and to establish a permanent group to oversee the entire operation.

The new reporting system to be used in the UK is a web-enabled Incident Reporting System (IRS). In Incident Recording System – Questions and Lists (Edwards & Bailey, 2009) the Department for Communities and Local Government describes the questions that will be asked for each time of incident and the options given, the reasons for new data collection, comparison to FDR1 and current data collections, key concepts, and BVPI and NI calculations within the IRS.

4.5.2 Probabilistic Risk Assessment

Probabilistic risk assessment can be used with data gathered in fire-related incident reports to establish fire safety codes and regulations. Based on the determined risk evaluated, it can be decided upon whether or not to implement a code or regulation to try

to prevent a specific fire-related scenario. If the risk is determined to not be very high, it may be seen as not necessary to work towards establishing any sort of code or regulation as a preventative measure.

Part 7 of the United Kingdom's Application of Fire Safety Engineering principles to the Design of Buildings discusses probabilistic risk assessment and how it is used to assess the fire risk in buildings. Probabilistic risk assessment "sets out the general principles and techniques of risk analysis" and "is the generic term applied to studies where the objective is to generate a measure of risk" (National Fire Protection Association). Severity and frequency are both very important in determining the level of risk. A low consequence event that happens frequently can be as much of a concern as an event is very severe but happens infrequently.

Figure 7 is a recreation of the general approach to probabilistic risk assessment from the Application of Fire Safety Engineering principles to the Design of Buildings.

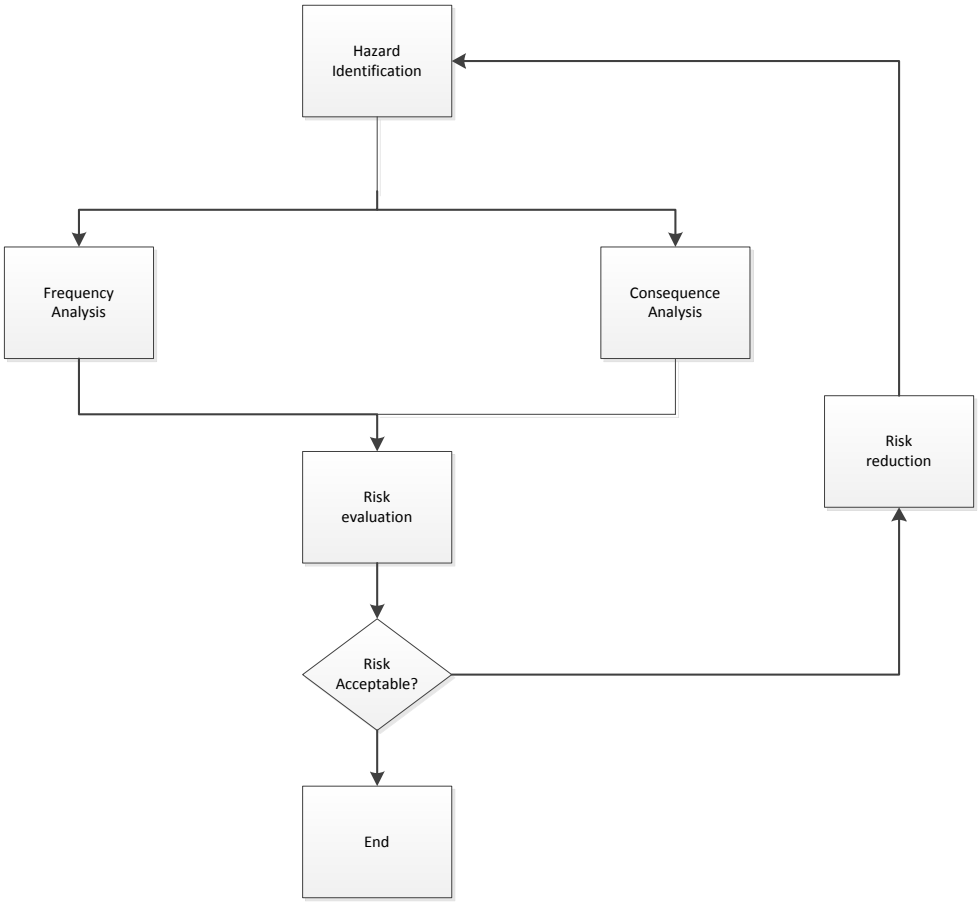

Figure 7: General approach to probabilistic fire risk assessment

Fire safety techniques assume that fires start, grow, and cause multiple events, related or directly caused by the fire's origin. Prescriptive building codes are based on this and are allowed for the "average building". During fires engineers look in great detail, how the course of the fire, affects the overall building and the people inside, which is different from prescriptive coding. Fire safety techniques are enhanced by considering possible casualties do to fire. These are used less because they force reviewers to believe a death related situation will occur. Also more commonly used is the most questionable scenario when a casualty scenario will not only occur, but compensation or value of one's life is applied, this determines how many deaths are allowed to happen based on the company's costs. These studies are also limited by the amount of data available, however are still applied to fire safety and engineering in all buildings and their designs. PRA and

Deterministic approaches help fill in the spots where data may be missing, this is done by using extreme data theory, and if the blanks are not filled in it can cause an inconsistent application. A full risk assessment is time consuming, however can be useful for standard solutions and for seeing failure.

4.6 Hong Kong

The Fire Services Department has about 9,100 uniformed personnel and about 600 civilian members. There are three operational Fire Commands, a Fire Safety Command, a Licensing and Certification Command, an Ambulance Command, a Fire Services Headquarters Command and an Administration Division. The operational command is in charge of overseeing the; West Division, Central Division, East Division, Marine and Offshore Islands, and Administration Group. Also, more specifically, the Hong Kong Operational Command's responsibilities include:

- Implementation of policies, orders, and instructions
- Personal command of firefighting and rescue operations
- Liaison on fire safety issues (Hong Kong Fire Service)

Hong Kong's mission is:

- To protect life and property from fire or other calamity
- To give advice on fire protection measures and fire hazards
- To educate the community and to promote the public awareness on fire safety
- To render paramedic ambulance services to the sick and the injured and convey them to the hospital

In Brazil, the fire and rescue service is responsible for; building project analysis, fire safety inspections, firefighting, fire investigation, search and rescue, and medical emergencies. When asked about fire safety culture in Brazil, George Braga, Federal District Fire Department, MAJ QOBM/Compl. Physics, prefaced by saying "…fighting fires is about 25% of our Fire Departments work. Most of our job is in EMS, but we have a lot of work doing fire design analysis and building inspection. But that's the case of Brasilia (Federal District), because we are a new city (build from scratch in 1960), with a 6,000 firefighters for a population of 2 million." According to Braga, every state in Brazil has a paid fire department but not all cities have a fire station. Also, on average, Brazil has one firefighter

per 2,850 inhabitants. But in some states the ratio of firefighters to inhabitants is much worse. For example, in Maranhão the ratio is one firefighter per 7,735 inhabitants.

Hong Kong's fire and rescue service establishes a set of targets and indicators every year to assess the performance of the fire and rescue services. This highlights the specific areas where improvement is needed. See Appendix E the targets and indicators for fire service, fire protection and prevention, and ambulance service. The fire statistics include; classification of fires, classification of fires by causes, occupancy where major fire occurred (No. 3 alarm and above), classification of special service, and injuries and fatalities.

"Always in readiness to serve the community of Hong Kong, we pledge to achieve our mission quickly and efficiently. Our aims are to respond to building fire calls within 6 minutes in built-up areas and within 9 to 23 minutes in areas of dispersed risks and isolated developments. Our target is to achieve these times in 92.5% of all calls in 2011. In 2010, the overall performance in responding to building fire calls was 2.4% above the target of 92.5%...emergency ambulance calls within 12 minutes from the time of call to the arrival of an ambulance at the street address. In 2011, our target is to meet this response time in 92.5% of all emergency calls. In 2010, the overall performance in responding to emergency ambulance calls was 0.4% below the target of 92.5%. We aim to improve our performance in 2011 by enhancing the new mobilizing system, commissioning new fire stations/ambulance depots at various locations and strategically deploying our emergency resources." (Fire Services Department)

Hong Kong knows exactly what the problems are in their fire and rescue service from comparing the fire and rescue service's performance with the targets and indicators. For example, if the fire and rescue service is having trouble responding to fires within their target time, they are aware of an area that may need more fire stations.

4.7 Summary of Analysis

Originally the goal of this project was to analyze the fire problem in Brazil, to evaluate successful fire incident reporting systems, and finally to take our understanding of these topics and suggest which specific attributes of these systems could help to solve issues currently prevalent in Brazil. However after conducting our research and analysis of the fire problem, it became clear that Brazil is not ready for a national fire incident reporting system.

The quality of life currently in Brazil is contrasted. While many citizens enjoy the comforts of a bustling economy, most do not. A quarter of the population of Brazil is below the poverty line (Central Intelligence Agency, 2011). Nearly 40% and 15% of citizens in favelas have an inadequate sewage systems and water supplies respectively (Table 1: Households and Environment).

The current building regulations in Brazil are not enforced properly (Tavares, 2009). If the government of Brazil cannot enforce its current regulations it should not spend the resources creating improved ones.

Currently, there are no university programs in fire protection engineering in Brazil. With few experts in the area, analyses of a database of information gathered from a reporting system would be a slow and cumbersome process. The universities of Brazil must work together to create the necessary programs, and encourage students to study them.

Finally, the fire safety culture of Brazil must be improved before the implementation of a reporting system. Until citizens are more aware of the fire risks present, how to prevent them, and the importance of understanding them, an advanced reporting system would be ineffective at improving the fire problem.

Until these issues are resolved, creation and implementation of a reporting system would be difficult, there would be little to now experts to analyze the data gathered from the system, and implementing any new regulations because of the data would be ineffective. It is because of these major issues that Brazil is not ready for a national fire incident reporting system.

5 Recommendations

Our recommendations for Brazil are suggestions that with implementation will bring Brazil closer to establishing a successful fire-related incident reporting system. At this time, research has shown that, Brazil is not ready for a national fire incident reporting system (Tavares, 2009). There are some specific areas that we have highlighted in this report that if improved, will bring Brazil significantly closer to be in a position to create an effective national fire incident reporting system.

5.1 Fire Safety Culture

The fire safety culture of Brazil must be improved in order for government officials, private corporations, and the citizens to take the safety of the public more seriously. Fire safety culture is affected by and affects every aspect of the fire problem, including the effectiveness of the fire brigades, the fire incident reporting system, and the awareness of the public. Because of this, all of our recommendations should improve the fire safety of the public of Brazil, as well as the overall fire problem.

5.2 Government Officials

Building codes are not strictly enforced, especially in the favelas. Only when a catastrophic event occurs is there any awareness to the issue and how important it is to public safety. Once this occurs, officials and the general public are much more compliant in ensuring that all buildings are up to date with the established regulations.

These regulations must be enforced prior to any emergency situations if they are to protect the citizens. A regulatory committee could be established whose responsibility is to take legal action against building regulation offenders. If there are legal and harsh penalties, such as a system of fines possibly based on that of the United Kingdom's, for not maintaining safe environments, building owners will have reason to meet the regulations.

5.3 Education & Training

Statistics gathered from fire incidents can be used to establish fire service training programs and to decide what equipment is needed in each fire service area. In Brazil there

are an inadequate number of trained personnel to sufficiently cover Brazil. With the majority of Brazilian administrative districts and cities lacking a fire brigade, there is a great need for additional personnel.

5.3.1 Military

The fire and rescue service in Brazil is mainly military based with some volunteer fire brigades. Since it is very militarized, it would probably be best not to change the military's involvement. Rather work with or around the military fire brigades, creating additional volunteer fire brigades.

There is a history of corruption in public service, specifically noted in the police force with continuous problems that include inadequate salary scales. This is important to be aware of and attempt to correct, especially since the firefighters are currently getting arrested for protesting because of inadequate salaries.

5.3.2 Volunteer

Brazil is similar to Finland in the fact that they are both divided up into municipalities which are independent and are responsible for the fire and rescue services in their region. Finland's municipalities also decide on how to structure their fire brigades; with professional, half-ordinary, and volunteer fire brigades. Finland's volunteer fire brigades cover 95% of Finland and 47% of the population. Finland has found that an advantage of letting each municipality independently decide on how to structure their fire and rescue services is that they can be specifically designed to provide the necessary service most effectively and efficiently for each region. They individually decide what tasks the fire and rescue services will handle in each municipality held within the region. Brazil's also has independently run municipality specific fire and rescue services, with professional and volunteer firefighters. Since Brazil's fire and rescue services are organized very similarly to Finland's, implementing certain features of Finland's fire and rescue service procedures or aspects of Finland's fire-related incident reporting system could be possible. This could significantly improve the efficiency and effectiveness of Brazil's fire and rescue service and fire-related incident reporting system.

5.3.3 General Public

The example of the Brazilian farmers in the Xingu region is an excellent instance where educating the general public on better practices when dealing with fire or ways to avoid using fire, significantly reduces the number of fires. When local farmers were educated on alternate and more modern techniques to clear land, and given assistance creating a local trained fire brigade, the number of fires reduced by 80 percent.

5.3.4 Youth

Leadership in Brazil needs to set an example of fire safety culture if the nation's is to improve. Children must be taught the risks of fire, and common accidental causes of it. They must also be instructed on what actions to take in the event of a fire. In the United States, classrooms have posters illustrating the proper actions to take in emergency events, which remind children, without necessarily taking any time from their studies. If the children of the nation are informed of fire risks they may behave more carefully, as well as share their knowledge with parents and family.

Educating children through school programs is an inexpensive way to increase their awareness of risk, and their ability to avoid it. As discussed prior, the elements of safety culture, an example of which is fire safety culture, are intertwined with one another. Increasing the ability to identify fire risk also improves the ability to identify other safety risks. We recommend that a more time be set aside in schools for educating children of these risks.

5.4 Favelas

In order to offer satisfactory fire protect to all of its citizens, Brazil must solve, or mitigate the favela issue. For the time being we recommend improving the infrastructure of such areas, with the focus on adequate pressurized water systems, and better (ideally paved) roads where ever possible. Brazil must first ensure that the fire brigades have the ability to reach the fire they are combating, as well as the resources to combat it.

It is beyond the scope of this IQP to research the socio-economic reasons behind the construction or the inhabiting of the favelas, and therefore we cannot recommend a course

of action to take to stop their development. However future construction of both informal and formal settlements needs to be prepared for a higher population density then is present. This means wider roads, larger sidewalks, and more robust public utilities such as sewage, water, and public transportation.

5.5 Fire Protection Equipment

In the past Brazil has had problems in fire departments where the lack of resources result in a lack of a sufficient budget, old or outdated equipment, and problems with recruiting and retaining members. But Brazil's economy is continually improving; education, health, and the living standards have also improved. With all of these improvements and the improving economy, there will be more money that the government could allocate for the fire and rescue services to improve their program.

To combat Brazil's problem of responding to fire-related incidents is dense cities, such as Rio de Janeiro and São Paulo, Brazil could take an approach similar to Singapore with their specifically designed emergency vehicles. A motorcycle can pass through traffic more easily than a full sized fire truck, and may be the only option in navigating a favela. This allows the occupant of the fire bike to assess the fire situation present and inform backup where and how to setup equipment to most efficiently combat the fire, or if necessary combat the fire themselves.

5.6 Fire Reporting System

By implementing a national fire incident reporting system, it would be possible to collect data that could be used to; develop building and fire codes, establish fire prevention programs, and implement other public safety applications. Also, Brazil would be able to begin using performance-based codes if they so choose.

When Brazil is finally ready to consider implementing a new fire-related incident reporting system, our recommendation is to first assess the current system for fire reporting and look at how they are used and their purpose. Create a table similar to Table 6, recreated from the Review of the National Fire and Rescue Incident Statistics Collection.

Table 6: Collection and Analysis of Fire Data - The Current Position

Hierarchy of Reports	Normally Completed by	Typically Used by	Purpose	Additional or Subsequent use
FDR3	Fire and Rescue Service	ODPM	To compile National Statistics	To inform research and policy
		F&RS	To inform IRMPs and Community Safety Plans	
Local Performance	Fire and Rescue Service	Police, Local Safety Partnerships, Crime & Disorder Partnerships	Usually to identify local fire-raising activity and patterns	
FDR1	Fire and Rescue Service	ODPM	To compile National Statistics	To inform research and policy
		F&RS	To inform IRMPs and Community Safety Plans	
		Insurers	To inform response to policy claims	To inform insurance risk assessment
		Coroners	To inform the Court	To make recommendations
		Criminal Justice System	To inform the Court	
FDR2	Fire and Rescue Service	As FDR1	Amends FDR1	As FDR1
Fire Investigation Report	Fire and Rescue Service	As FDR1	As required by F&RS	As FDR1
Fire of Special Interest	Fire and Rescue Service	HM Fire Service Inspectorate	To monitor events which may have national implications for public or fire-fighter safety	To provide briefing for ministers
Scientific Investigation	Scenes of Crime Officer	Criminal Justice System	To inform the Court	
	Forensic Scientist	Criminal Justice System	To inform the Court	
		Insurers	To inform response to policy claims	To inform insurance risk assessment
	Building Research Establishment	ODPM	To inform building regulation	

This table organizes and shows who uses each of the fire-related incident reports and their purpose for looking at it. It explains how the data would ideally flow through the system. A new system would, ideally, be an improvement on the old system that would result in faster reporting and less necessary training; saving significant time, energy, and resources. It is important to look at what is already in place and to only modify it unless there are sufficient time and resources to investigate and establish a completely new system. By only making modifications to the current system in place, there will be a greater probability of successful implementation.

Brazil, being a large country, has many different types of fire scenarios. So having only one general fire-related incident reporting form to cover all types of fires and all situations is not realistic. By using this table the United Kingdom found that when there are these general forms to cover all situations, less data actually gets reported. It was inconvenient to have a reporting system where significant portions of the form have irrelevant sections, just for the convenience of having a form that can be applied to any fire-related incident. The solution to this problem, and what we are suggesting to Brazil, is to create specific reports for different types of fires. Each classification of fire would have its own type-specific form.

5.6.1 Implementation

In order to implement a new system there are some recommendations that should be considered according to the Review of the National Fire and Rescue Incident Statistics Collection; it is recommended that a particular set of data that satisfies the majority of the needs, brigades are in agreement on the necessary set of data to be shared between brigades involved in an incident that encompasses multiple jurisdictions, everything is clearly defined and understandable, there is a standard in place for validation, format and layout, and to establish a permanent group to oversee the entire operation.

The firefighters need to understand the importance of the data that needs to get reported. In the United Kingdom a big problem was the lack of firefighters' understanding of the importance of what they are supposed to be reporting. Unsatisfactory quality data is a result of the easier option is selected rather than an accurate representation of the fire-

related incident that has transpired. The necessity of the data is not always clear to the brigades, leading to missing or inaccurate incident reports. Proper classification of fires is a struggle for firefighters. That along with the difficult field codes sets up a situation perfect for incorrectly reporting the information, thereby skewing the statistics. When implementing a new system, be sure not to make too many major changes or include too many unnecessary parts; keep it as simple as possible. Implementation will be easier the simpler the new reporting system is.

5.6.2 Assessment

With an effective reporting system in place, fire brigades' performance can be assessed and changes can be made to improve it.

In order to assess the performance of the fire brigades in Brazil, a system similar to Hong Kong's targets and indicators could be implemented. Hong Kong's yearly established set of targets and indicators for their fire brigades highlight the specific areas within the fire brigade's performance that need improvement. If Brazil were to implement this system for their fire brigades, they would know exactly where the fire and rescue service's faults are and would be able to rectify the situation efficiently.

6 Conclusion

Currently the fire problem of Brazil is in need of improvement. When we created our mind map, we considered the effects of a fire reporting system on a Brazil's fire problem, however because the current system is not national, comparatively unsuccessful, information was not readily available, and perhaps most importantly because we feel that there are more important issues that Brazil needs to resolve before implementing a national fire reporting system, we determined that its analysis should be left to another IQP. The issues which are hindering the development of a national fire incident reporting system of Brazil include a poor national Fire Safety Culture, outdated and poorly enforced building regulations, and large informal settlements which create difficulty for the fire brigades. After analyzing these issues in detail, as well as how the fire brigades and incident reporting systems of other countries have overcome similar problems, we have made recommendations for changes and improvements. Implementing these recommendations should move Brazil into a better position to implement an effective national fire incident reporting system, and to improve the fire problem overall.

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8 Appendices

8.1 Appendix A

Contact Name	Position	Email Address
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Dr. John Hall Jr.	Assistant VP, Fire Analysis and Research Division, NFPA	jhall@nfpa.org
Paul Jenkins	Fire Engineer, London Fire Brigade	paul.jenkins@london-fire.gov.uk
Professor Ai Sekizawa	Tokyo University of Science	sekizawa@rs.kagu.tus.ac.jp
Heng Chai Liang	Assistance Direction, Singapore Civil Defense Force	heng_chai_liang@scdf.gov.sg
Matthew Wright	Chief Technical Officer, Fire Protection Association Australia	matthew.wright@fpaa.com.au
Frieder Kircher	Berlin Fire Brigade	frieder.kircher@berliner-feuerwher.de
Per-Erik Johansson	Director, Swedish Fire Research Board	frieder.kircher@berliner-feuerwher.de
Dr. Paula Beever	National Director Fire Risk Management New Zealand	Paula.Beever@fire.org.nz
Dr. George Cajaty Barbosa Braga	University of Brasilia	george@unb.br
Mr. Fernando Vigara	Consultant and President, Iberio-American Chapter of Society of Fire Protection Engineers	fvigara@adventis-ingenieria.es
Lieutenant-Colonel Ronan Poliverd	Chief of Fire Prevention, Paris Fire Brigade	chefbureauprevention@pompiersparis.fr
Mr. Jean-Raphael Ronse	President, French Chapter of SFPE	sfpe@wanadoo.fr

8.2 Appendix B

Dear [Professor / Dr. /Mr. /Ms. CONTACT]:

My name is Jeremy Francisco. I am a student at Worcester Polytechnic Institute (WPI) in the USA. I am writing to you in regards to an undergraduate research project being conducted under the guidance of Professor Brian Meacham. I am working with two other students, Barbara Hall and Marissa Imperiali.

My project involves researching the fire reporting systems in use in various countries. By fire reporting system, I mean a system where fire departments report incidents to a national database, such as the National Fire Incident Reporting System in the United States. One aspect of our research relates to how accurate and useful the fire statistics are for identifying and addressing the fire safety problem in the country.

Following is short list of questions which we think will help us better understand the situation in Brazil. My partners and I would sincerely appreciate any answers that you may have for the following questions, as well as any other information or resources you could point us to or provide to us. If you are not the most appropriate person to answer these questions, it would be greatly appreciated if you can provide us with contact information for someone who might be in a better position to assist us.

Is there an official fire incident reporting system in place within Brazil?

If so, can you tell us what data are reported, and how many fire departments participate in program?

Could you perhaps provide us with a sample of information collected from a fire, or an explanation of how it is collected?

To what extent is data collected? For example, are data collected only for cities or are fires in rural communities collected as well? Also, within cities, is this system being utilized in the favelas as well? If so, what challenges to you face in collecting data? If not, what are the reasons for not collecting data in these areas?

How are the fire fighting forces in Brazil organized? We understand the organization is military based, but we have been unable to find a detailed explanation of the structure.

Again, my partners, advisor, and I appreciate any feedback that you may have for us on the above questions. If you have any questions for us, or would like additional information about our project, please do not hesitate to ask.

Sincerely,

Jeremy Francisco

8.3 Appendix C

8.3.1 Notice of Fire or Accident and its confirmation

Calling the Fire Department remain calm and report:

- Local fire or accident, stating the address containing:
    - neighborhood, street, n. thereof, reference point;
- Your name and phone number;
- Actual situation of the fire or accident;
- Existence of victims or not;
- Risk of explosions, etc. and
- Still answering any questions the Military Operations Center

8.3.2 Tips for the Prevention of Accidents

8.3.2.1 Prevention of Accidents with Electricity

- Maintain facilities in good to avoid overcharging, poor contact and short circuit.
- Do not use plugs and wires in poor conditions or lower the recommended gauge.
- Never replace fuses or circuit breaker for direct connections with wires or currencies.
- Do not overload electrical outlets with multiple devices connected at the same time, because the wires get hot and cause a fire.
- Never leave electric iron on while you have to do something else, even for a few minutes, as this has been the cause frequent fires.
- Note that the holes and air vents of home appliances (like TV, video and microwave ovens) are not closed for cloths decorative covers, etc.
- Do not leave lamps, candles and heaters near curtains, paper and other combustible materials.
- If the house is unoccupied for an extended period, turn off the main electrical switch.

8.3.2.2 Prevention of Accidents with Gas

- Handle gas cylinders with care to avoid falling or suffer strokes.
- The cylinders should be stored in well clean, well ventilated, free from oil and grease, protected from rain, sun and other heat sources.
- Domestic Gas Cylinders should not be together the stove, but outside the home and connected to metal pipes.
- If the gas is installed inside the house and he comes to leak, do not scratch or match and light up or turn off lights. Call the fire brigade and if possible remove the canister from home. Open doors and windows, cut power to the clock, and stay away from where the gas is leaking.
- When installing a new cylinder use soapy water to test for leaks. Never use a flame for this purpose, but remember: the soap should not be used to seal leaks.
- When lighting a stove oven, strike the match first and then open the gas.
- If the house is unoccupied for an extended period, close the gas cock.

8.3.2.3 Ventilation in Doors and Overhead

For your safety, do not forget that kitchens, bathrooms and service areas with gas appliances should have an area of permanent ventilation with the following characteristics:

- In the window: fixed weighbridges open, with a minimum of 600 cm ^{2} free area.
- At the door: at the bottom, shutter, trellis or cut 3 cm high, with at least 200 cm ^{2} free area.
- Do not eliminate or reduce the permanent ventilation of the environments that have gas appliances.

8.3.2.4 Prevention of Accidents in the Kitchen

- Do not use plastic bags or towels in the kitchen.

- When you leave, check that nothing was on and no risk of fire would endanger his residence.
- Do not place cloth or decorative paper near the stove.
- The cables of the pots should be directed to the center of the stove
- Kitchen is no place for children; do not let them stay there alone.
- Leave matches or lighters within the reach of children is an attack on his home and the physical integrity of same.
- When you grab a hot pan, make sure you get moving it to avoid falling from his hands.

8.4 Appendix E

8.4.1 Fire Service

The following tables are examples of the Targets and Indicators system in Hong Kong. Table 7 and Table 8 show targets set by the fire brigades, such as fire calls met within a graded response time, and the actual results of the brigade. The program was started in 2006 and the data shows that improvements made between then and 2009, as most of the results improve. However, most of the data indicates that in 2010 the department struggled to improve or equal the performance of previous years. With this information the fire brigades can determine that changes made between 2009 and 2010 may have been detrimental to their overall performance, allowing them to reconsider these changes.

Table 7: Targets for the Fire Service

	Target	2006 (Actual)	2007 (Actual)	2008 (Actual)	2009 (Actual)	2010 (Actual)	2011 (Plan)
total building fire calls met within graded response time (%)	92.5	93.9	94.3	94.7	95.6	94.9	92.5
fire calls met within graded response time of six minutes for built-up areas (%)	92.5	93.6	94.1	94.6	95.5	94.8	92.5
fire calls met within graded response time of nine to 23 minutes for more dispersed risk/isolated developments (%)	94.5	96.7	96.1	96	96.3	96.1	95
complaints of imminent fire hazards answered within 24 hours (%)	100	100	100	100	100	100	100
requests for fire drills, fire safety talks, seminars, exhibitions, meetings and operational visits attended (%)	100	100	100	100	100	100	100

Table 8: Indicators for the Fire Service

	2006 (Actual)	2007 (Actual)	2008 (Actual)	2009 (Actual)	2010 (Actual)	2011 (Plan)
all fire calls	33268	31638	35513	35771	40604	36000
building fire calls in built-up areas	25556	23837	26856	27244	32094	27500

building fire calls in more dispersed risk/isolated developments	2615	2601	2866	3388	3973	3500
special service calls	21383	22083	24398	25069	26859	27000
emergency ambulance calls attended by first responders	25223	38917	40719	43619	49451	54000
turnouts of fire appliances to emergency calls	121655	115184	124602	125852	139026	137000
emergency move-ups of fire appliances to provide operational coverage	25353	35135	43741	46251	51445	52000
complaints of imminent fire hazards received	4411	4345	4462	4712	4739	4800
Fire Hazard Abatement Notices issued in respect of floating obstructions to means of escape (MOE) and locked exits	449	732	1037	1152	1756	1700
prosecutions instituted	45	46	41	69	84	80
inspection of hospital/clinics	346	373	392	387	427	380
lectures and advisory services given to hospitals/clinics	464	617	608	692	720	700
inspection of fire service installation (FSI) to verify the accuracy of maintenance certificates	4190	4076	4987	5265	5724	5500

8.4.2 Fire Protection and Prevention

Table 9 shows the performance of the fire department in preventing fires by issuing regulations regarding transport and storage of dangerous goods, manufacturing, and public areas such as schools. Specifically the data shows that nearly all of the administrative regulations regarding the above topics and more, are handled quickly and efficiently (most being completed within 20 days).

Table 9: Targets for Fire Protection and Prevention

	Target	2006 (Actual)	2007 (Actual)	2008 (Actual)	2009 (Actual)	2010 (Actual)	2011 (Plan)
safety requirements issued within 28 working days for storage/manufacture of Category 2 (other than LPG) to Category 10 dangerous goods and/or for storage of timber following receipt of	100	100	100	100	100	100	100

application and the required details/plans in full (%)							
safety requirements issued within six working days for vehicles used for conveyance of Category 2 (other than LPG) or Category 5 dangerous goods following receipt of application (%)	100	100	100	100	100	100	100
licenses issued within six working days for storage/manufacture of Category 2 (other than LPG) to Category 10 dangerous good and/or storage of timber upon confirmation of full compliance with safety requirements (%)	100	100	100	100	100	100	100
licenses issued within six working days for vehicles used for conveyance of Category 2 (other than LPG) or Category 5 dangerous goods upon confirmation of full compliance with safety requirements (%)	100	100	100	100	100	100	100
fire safety requirements issued within 20 working days for the licensing/registration of schools, child care centers, food premises, places of public entertainment karaoke establishments, and drug dependent centers following receipt of application and the required details/plans in full (%)	90	---	100	100	100	100	90

Fire Services Certificates issued within seven working days upon confirmation of full compliance with fire safety requirements for all license/registration applications (%)	90	---	100	100	100	100	90
complaints about dangerous goods (other than LPG) or reports of fire hazards posing imminent danger investigated within 24 hours (%)	100	100	100	100	100	100	100
complaints about fire hazards not posing imminent danger investigated within ten working days (%)	100	100	100	100	100	100	100
complaints advised within 27 working days of outcome of investigation (%)	100	100	100	100	100	100	100
applications processed within seven working days for registration as FSI contractors (%)	100	100	100	100	100	100	100
letters of approval issued within 14 working days to applicants for registration as FSI contractors upon completion of all formalities (%)	100	100	100	100	100	100	100
no. of prescribed commercial premises inspected	150	141	150	150	150	150	150
no. of specified commercial buildings inspected	40	141	100	31	40	40	40
no. of composite buildings inspected	1150	908	905	842	1001	1150	1150

Table 10: Indicators for Fire Protection and Prevention

	2006 (Actual)	**2007 (Actual)**	**2008 (Actual)**	**2009 (Actual)**	**2010 (Actual)**	**2011 (Plan)**
licenses renewed/issued	4340	4203	4363	4311	4350	4350
timber/dangerous goods stored	1767	1786	1738	1724	1872	1900
dangerous goods vehicles						

Fire Hazard Abatement Notices issued (other than floating obstructions to MOE and locked exits)	2039	2264	4951	3968	3865	4000
prosecutions instituted	313	419	281	204	170	170
dangerous goods and timber stores fire hazards	128	109	92	81	148	150
building plans processed	12488	12683	12277	13519	13824	13500
inspection of FSIs and equipment	82807	86813	102730	145750	146505	147000
applications for approval of portable firefighting equipment and FSI/equipment processed	775	361	395	553	709	700
inspection of fire safety in schools, child care centers, food premises, places of public entertainment, karaoke establishments and drug dependent persons treatment and rehabilitation centers	33613	35376	36208	39178	41678	43000
inspection of fire safety in commercial premises and composite buildings	14418	15228	17792	20846	25372	25500
inspection of ventilating systems in buildings and licensed premises	6051	6215	7043	10137	10917	11000
lectures and advisory services given (other than hospitals/clinics)	27764	29568	38072	46390	51337	52000
prescribed commercial premises	823	804	802	800	800	800
no. of fire safety directions issued						
no. of fire safety directions complied with/discharged	924	923	747	808	858	800
specified commercial buildings	4766	4705	3010	2998	2998	3000
no. of fire safety improvement directions issued	7473	4929	4051	3997	4001	4000
no. of fire safety improvement directions complied with/discharged						
composite buildings	900	354				
no. of buildings issued with advisory letters	9546	11557	---	---	---	---
no. of advisory letters issued	---	6442	---	---	---	---
no. of fire safety directions issued			12560	13690	14032	15000
no. of fire safety directions complied with/discharged	---	---	525	4420	4310	4500

8.4.3 Ambulance Service

Table 11 and Table 12 show the performance of the ambulance services in response time, as well as the number of responses. These targets and indicators provide the ambulatory services with the ability to determine coverage, and if more ambulances are needed. By documenting the number of emergency calls made per year, the services can predict whether their current resources will soon be inadequate, which would allow them to respond accordingly before it becomes an issue.

Table 11: Targets for the Ambulance Service

	Target	2006 (Actual)	2007 (Actual)	2008 (Actual)	2009 (Actual)	2010 (Actual)	2011 (Plan)
emergency calls answered within the target response time of 12 minutes (%)	92.5	92.7	92.8	92.2	92	92.1	92.5

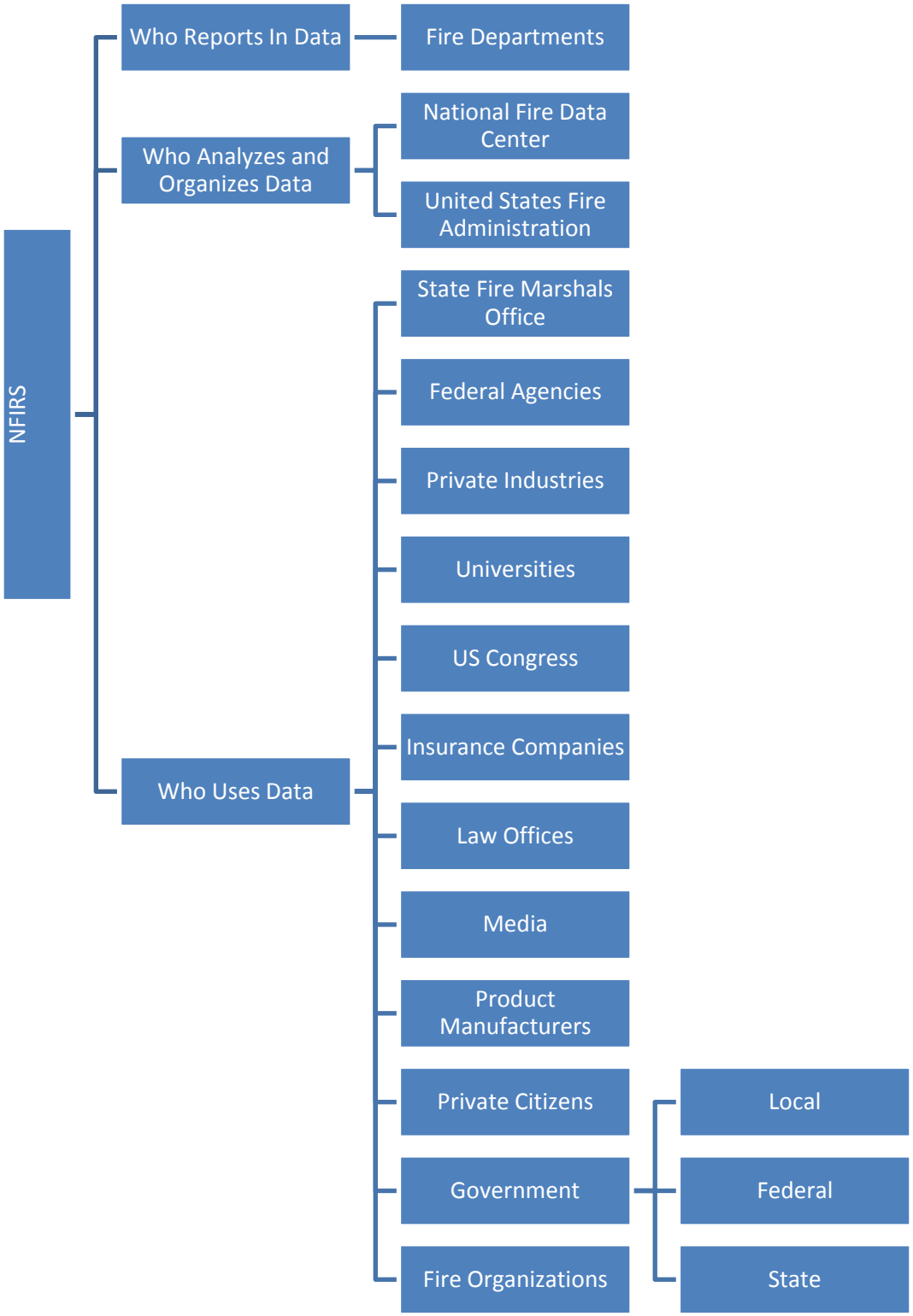
Table 12: Indicators for the Ambulance Service

	2006 (Actual)	2007 (Actual)	2008 (Actual)	2009 (Actual)	2010 (Actual)	2011 (Plan)
no. of emergency calls	539903	573657	600828	617265	646733	677000
no. of hospital transfer calls	34771	36916	41695	40845	39345	40500
calls per ambulance	2227	2367	2490	2551	2619	2591
turnouts of ambulances, ambulance motor cycles and Rapid Response Vehicles to calls	627979	667505	700029	715844	743755	776000
emergency move-ups of ambulances to provide operational coverage	45630	66619	61975	59523	67166	68000

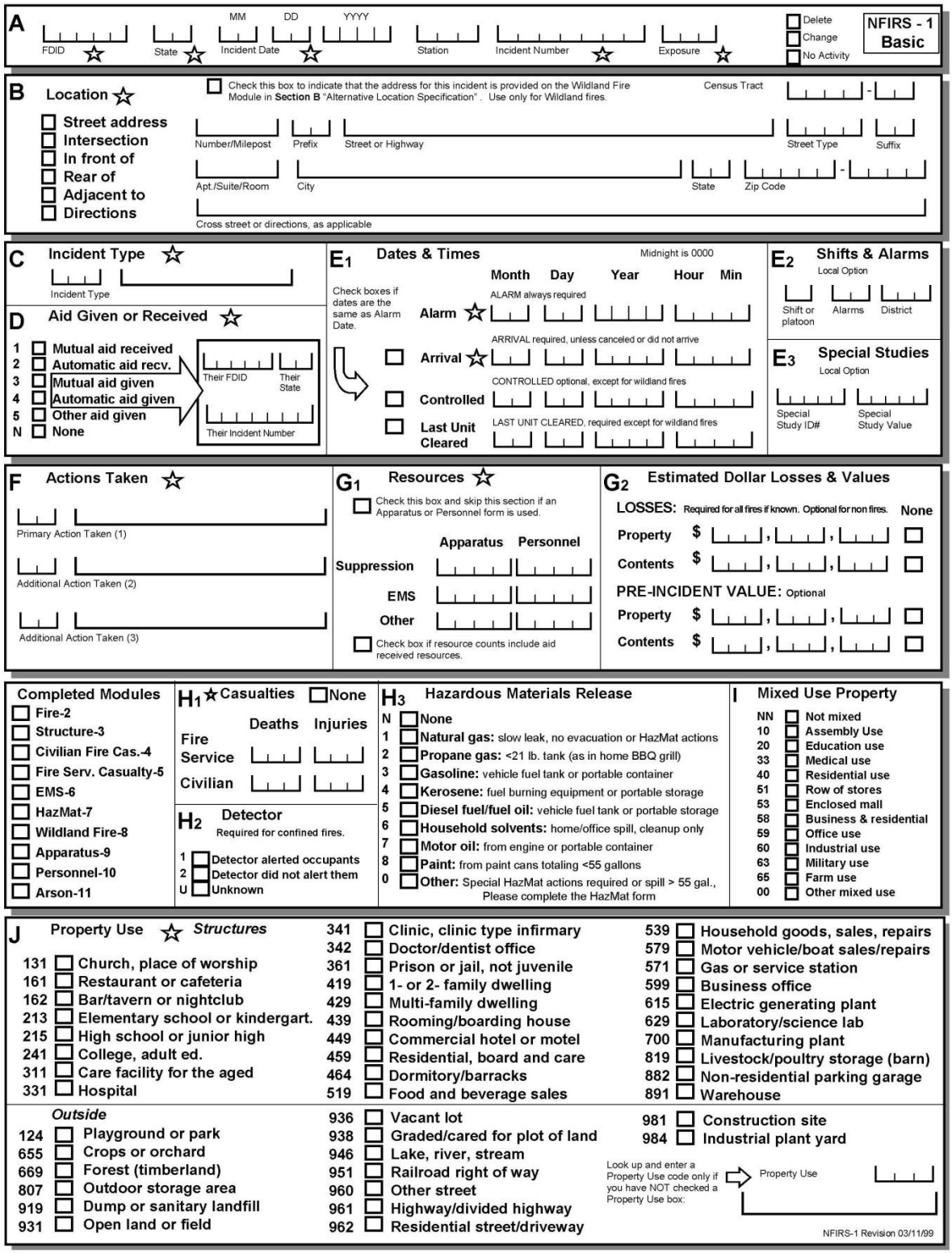
8.5 Appendix F

List of Brazilian States by Population Density				
Rank	**State**	**Area (km^2)**	**Population**	**Density (Population per km^2)**
A	Distrito Federal	5801.9	2383784	410.8626484
1	Rio de Janeiro	43696.1	15561720	356.1352157
2	São Paulo	248209.4	41055734	165.4076518
3	Alagos	27767.7	3050652	109.8633304
4	Sergipe	21910.3	2000738	91.31495233
5	Pernambuco	98311.6	8502603	86.48626408
6	Espirito Santo	46077.5	3464285	75.18387499
7	Paraiba	56439.8	3623215	64.19609921
8	Santa Catarina	95346.2	5958266	62.49085963
9	Rio Grande do Norte	52796.8	3043760	57.65046366
10	Ceara	148825.6	8217085	55.21284645
11	Parana	199314.9	10387378	52.11541134
12	Rio Grande do Sul	281748.5	10963219	38.91136599
13	Minas Gerais	586528.3	19479356	33.21128068
14	Bahia	564692.7	13950146	24.70396022
15	Maranhao	331983.3	6184538	18.62906357
16	Goias	340086.7	5730753	16.85085891
17	Piaui	251529.2	3036290	12.07132214
18	Rondonia	237576.2	1562417	6.576487881
19	Mato Grosso do Sul	357125	2297981	6.434668533
20	Para	1247689.5	7110465	5.698905858
21	Tocantins	277620.9	1332441	4.799498165
22	Acre	152581.4	686652	4.500233973
23	Amapa	142814.6	615715	4.311288902
24	Mato Grosso do Sul	903357.9	2856999	3.16264351
25	Amazonas	1570745.7	3311026	2.107932557
26	Roraima	224299	403344	1.798242524

8.6 Appendix G



8.7 Appendix H



K1 Person/Entity Involved

Local Option

Business name (if applicable) | Area Code | Phone Number

☐ Check this box if same address as incident location. Then skip the three duplicate address lines.

Mr., Ms., Mrs. | First Name | MI | Last Name | Suffix

Number | Prefix | Street or Highway | Street Type | Suffix

Post Office Box | Apt./Suite/Room | City

State | Zip Code

☐ **More people involved? Check this box and attach Supplemental Forms (NFIRS-1S) as necessary.**

K2 Owner

Local Option

☐ Same as person involved? Then check this box and skip the rest of this section.

Business name (if applicable) | Area Code | Phone Number

☐ Check this box if same address as incident location. Then skip the three duplicate address lines.

Mr., Ms., Mrs. | First Name | MI | Last Name | Suffix

Number | Prefix | Street or Highway | Street Type | Suffix

Post Office Box | Apt./Suite/Room | City

State | Zip Code

L Remarks:

Local Option

Fire Module Required?

Check the box that applies and then complete the additional Fire mod. based on Incident Type as follows:

☐ Buildings 111	Complete Fire & Structure
☐ Special structure 112	Complete Fire Mod. & the I block on Structure Module
☐ Confined 113-118	Complete Basic Module
☐ Mobile Property 120-123	Complete Fire Module
☐ Vehicle 130-138	Complete Fire Module
☐ Vegetation 140-143	Complete Fire or Wildland
☐ Outside rubbish fire 150-155	Complete Basic Module
☐ Special outside fire 160-164	Complete Fire Module
☐ Crop fire 170-173	Complete Fire Module

ITEMS WITH A ☆ MUST **ALWAYS** BE COMPLETED!

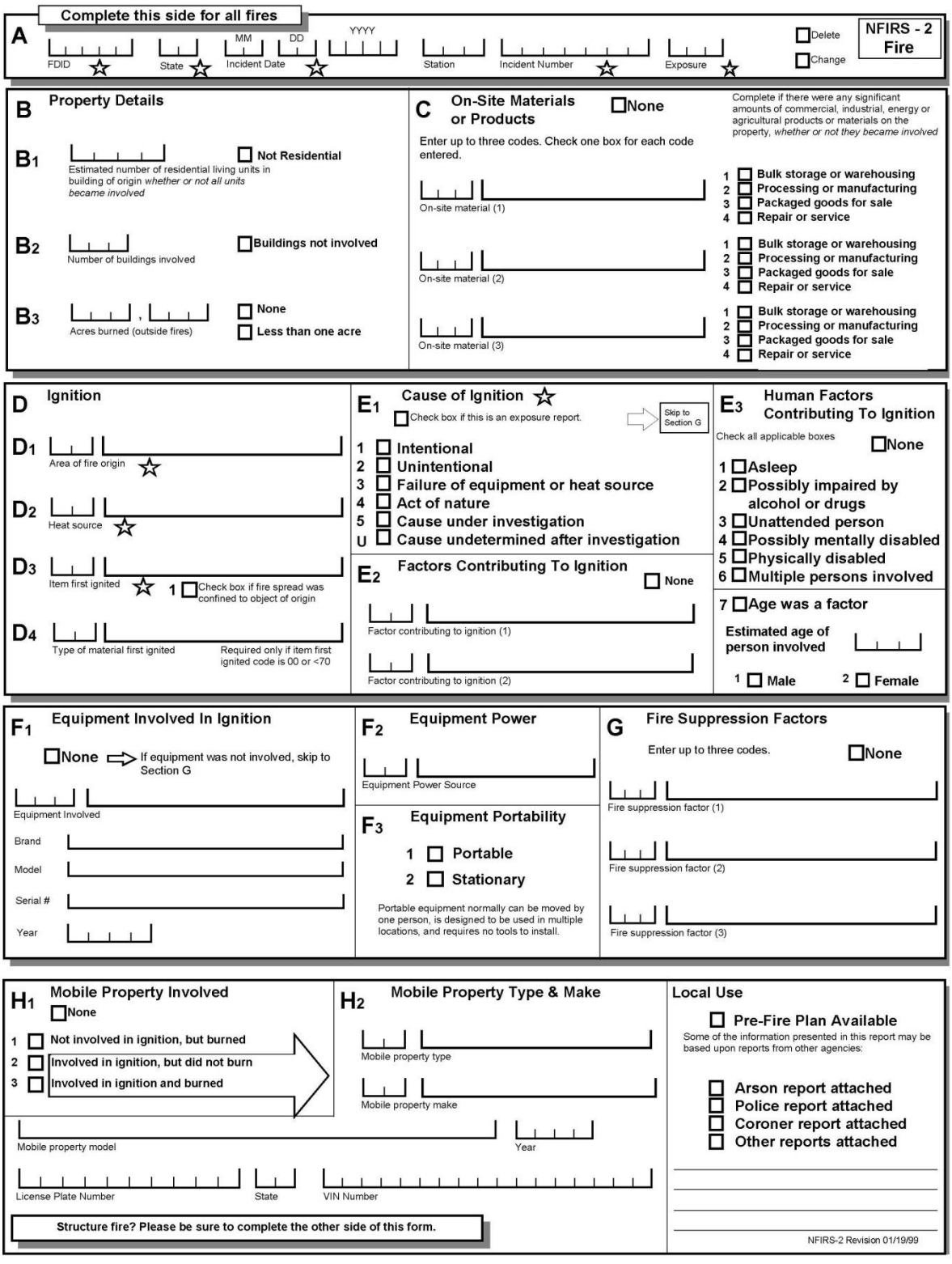
☐ **More remarks? Check this box and attach Supplemental Forms(NFIRS-1S) as necessary.**

M Authorization

Officer in charge ID | Signature | Position or rank | Assignment | Month | Day | Year

Check box if same as Officer in charge. ⇨ ☐

Member making report ID | Signature | Position or rank | Assignment | Month | Day | Year


Complete this side for all fires
A
FDID
State
MM
DD
Incident Date
YYYY
Station
Incident Number
Exposure
Delete
Change
NFIRS - 2
Fire
B
Property Details
B1
Estimated number of residential living units in building of origin whether or not all units became involved
Not Residential
B2
Number of buildings involved
Buildings not involved
B3
Acres burned (outside fires)
None
Less than one acre
C
On-Site Materials or Products
None
Enter up to three codes. Check one box for each code entered.
Complete if there were any significant amounts of commercial, industrial, energy or agricultural products or materials on the property, whether or not they became involved
On-site material (1)
On-site material (2)
On-site material (3)
1 Bulk storage or warehousing
2 Processing or manufacturing
3 Packaged goods for sale
4 Repair or service
D
Ignition
D1
Area of fire origin
D2
Heat source
D3
Item first ignited
1 Check box if fire spread was confined to object of origin
D4
Type of material first ignited
Required only if item first ignited code is 00 or <70
E1
Cause of Ignition
Check box if this is an exposure report.
Skip to Section G
1 Intentional
2 Unintentional
3 Failure of equipment or heat source
4 Act of nature
5 Cause under investigation
U Cause undetermined after investigation
E2
Factors Contributing To Ignition
None
Factor contributing to ignition (1)
Factor contributing to ignition (2)
E3
Human Factors Contributing To Ignition
Check all applicable boxes
None
1 Asleep
2 Possibly impaired by alcohol or drugs
3 Unattended person
4 Possibly mentally disabled
5 Physically disabled
6 Multiple persons involved
7 Age was a factor
Estimated age of person involved
1 Male
2 Female
F1
Equipment Involved In Ignition
None
If equipment was not involved, skip to Section G
Equipment Involved
Brand
Model
Serial #
Year
F2
Equipment Power
Equipment Power Source
F3
Equipment Portability
1 Portable
2 Stationary
Portable equipment normally can be moved by one person, is designed to be used in multiple locations, and requires no tools to install.
G
Fire Suppression Factors
Enter up to three codes.
None
Fire suppression factor (1)
Fire suppression factor (2)
Fire suppression factor (3)
H1
Mobile Property Involved
None
1 Not involved in ignition, but burned
2 Involved in ignition, but did not burn
3 Involved in ignition and burned
H2
Mobile Property Type & Make
Mobile property type
Mobile property make
Mobile property model
Year
License Plate Number
State
VIN Number
Structure fire? Please be sure to complete the other side of this form.
Local Use
Pre-Fire Plan Available
Some of the information presented in this report may be based upon reports from other agencies:
Arson report attached
Police report attached
Coroner report attached
Other reports attached
NFIRS-2 Revision 01/19/99

I1 Structure Type ☆

If fire was in an enclosed building or a portable/mobile structure complete the rest of this form

1 ☐ Enclosed building
2 ☐ Portable/mobile structure
3 ☐ Open structure
4 ☐ Air supported structure
5 ☐ Tent
6 ☐ Open platform (e.g. piers)
7 ☐ Underground structure (work areas)
8 ☐ Connective structure (e.g. fences)
0 ☐ Other type of structure

I2 Building Status ☆

1 ☐ Under construction
2 ☐ Occupied & operating
3 ☐ Idle, not routinely used
4 ☐ Under major renovation
5 ☐ Vacant and secured
6 ☐ Vacant and unsecured
7 ☐ Being demolished
0 ☐ Other
U ☐ Undetermined

I3 Building Height ☆

Count the ROOF as part of the highest story

Total number of stories at or above grade

Total number of stories below grade

I4 Main Floor Size ☆

NFIRS-3 Structure Fire

Total square feet

OR

Length in feet BY Width in feet

J1 Fire Origin ☆

Story of fire origin

☐ Below grade

J2 Fire Spread ☆

2 ☐ Confined to room of origin
3 ☐ Confined to floor of origin
4 ☐ Confined to building of origin
5 ☐ Beyond building of origin

J3 Number of Stories Damaged By Flame

Count the ROOF as part of the highest story

Number of stories w/ minor damage (1 to 24% flame damage)

Number of stories w/ significant damage (25 to 49% flame damage)

Number of stories w/ heavy damage (50 to 74% flame damage)

Number of stories w/ extreme damage (75 to 100% flame damage)

K Material Contributing Most To Flame Spread

☐ Check if no flame spread OR same as material first ignited OR unable to determine → Skip to Section L

K1

Item contributing most to flame spread

K2

Type of material contributing most to flame spread

Required only if item contributing code is 00 or<70.

L1 Presence of Detectors ☆

(In area of the fire)

N ☐ None Present → Skip to section M
1 ☐ Present
U ☐ Undetermined

L2 Detector Type

1 ☐ Smoke
2 ☐ Heat
3 ☐ Combination smoke - heat
4 ☐ Sprinkler, water flow detection
5 ☐ More than 1 type present
0 ☐ Other _____
U ☐ Undetermined

L3 Detector Power Supply

1 ☐ Battery only
2 ☐ Hardwire only
3 ☐ Plug in
4 ☐ Hardwire with battery
5 ☐ Plug in with battery
6 ☐ Mechanical
7 ☐ Multiple detectors & power supplies
0 ☐ Other _____
U ☐ Undetermined

L4 Detector Operation

1 ☐ Fire too small to activate
2 ☐ Operated → Complete Section L5
3 ☐ Failed to operate → Complete Section L6
U ☐ Undetermined

L5 Detector Effectiveness

Required if detector operated.

1 ☐ Alerted occupants, occupants responded
2 ☐ Occupants failed to respond
3 ☐ There were no occupants
4 ☐ Failed to alert occupants
U ☐ Undetermined

L6 Detector Failure Reason

Required if detector failed to operate

1 ☐ Power failure, shutoff or disconnect
2 ☐ Improper installation or placement
3 ☐ Defective
4 ☐ Lack of maintenance, includes cleaning
5 ☐ Battery missing or disconnected
6 ☐ Battery discharged or dead
0 ☐ Other _____
U ☐ Undetermined

M1 Presence of Automatic Extinguishment System ☆

N ☐ None Present
1 ☐ Present → Complete rest of Section M

M2 Type of Automatic Extinguishment System

Required if fire was within designed range of AES

1 ☐ Wet pipe sprinkler
2 ☐ Dry pipe sprinkler
3 ☐ Other sprinkler system
4 ☐ Dry chemical system
5 ☐ Foam system
6 ☐ Halogen type system
7 ☐ Carbon dioxide (CO_2) system
0 ☐ Other special hazard system
U ☐ Undetermined

M3 Automatic Extinguishment System Operation

Required if fire was within designed range

1 ☐ Operated & effective (go to M4)
2 ☐ Operated & not effective (M4)
3 ☐ Fire too small to activate
4 ☐ Failed to operate (go to M5)
0 ☐ Other
U ☐ Undetermined

M4 Number of Sprinkler Heads Operating

Required if system operated

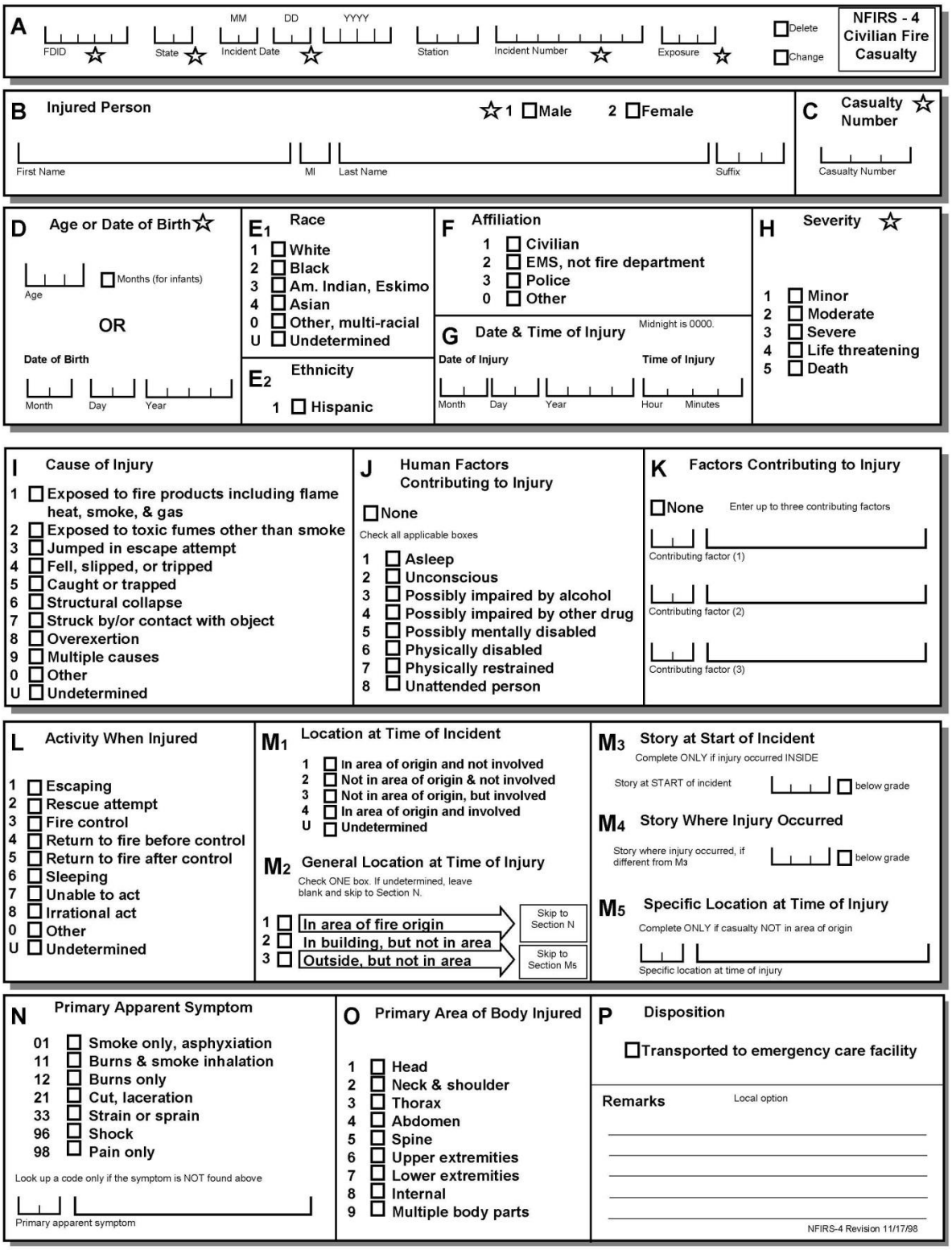
Number of sprinkler heads operating

M5 Automatic Extinguishment System Failure Reason

Required if system failed

1 ☐ System shut off
2 ☐ Not enough agent discharged
3 ☐ Agent discharged but did not reach fire
4 ☐ Wrong type of system
5 ☐ Fire not in area protected
6 ☐ System components damaged
7 ☐ Lack of maintenance
8 ☐ Manual intervention
0 ☐ Other _____
U ☐ Undetermined

NFIRS-3 Revision 01/19/99


A
FDID
State
MM
DD
YYYY
Incident Date
Station
Incident Number
Exposure
Delete
Change
NFIRS - 4
Civilian Fire
Casualty
B
Injured Person
1 Male
2 Female
First Name
MI
Last Name
Suffix
C
Casualty Number
Casualty Number
D
Age or Date of Birth
Age
Months (for infants)
OR
Date of Birth
Month
Day
Year
E1
Race
1 White
2 Black
3 Am. Indian, Eskimo
4 Asian
0 Other, multi-racial
U Undetermined
E2
Ethnicity
1 Hispanic
F
Affiliation
1 Civilian
2 EMS, not fire department
3 Police
0 Other
G
Date & Time of Injury
Midnight is 0000.
Date of Injury
Time of Injury
Month
Day
Year
Hour
Minutes
H
Severity
1 Minor
2 Moderate
3 Severe
4 Life threatening
5 Death
I
Cause of Injury
1 Exposed to fire products including flame heat, smoke, & gas
2 Exposed to toxic fumes other than smoke
3 Jumped in escape attempt
4 Fell, slipped, or tripped
5 Caught or trapped
6 Structural collapse
7 Struck by/or contact with object
8 Overexertion
9 Multiple causes
0 Other
U Undetermined
J
Human Factors Contributing to Injury
None
Check all applicable boxes
1 Asleep
2 Unconscious
3 Possibly impaired by alcohol
4 Possibly impaired by other drug
5 Possibly mentally disabled
6 Physically disabled
7 Physically restrained
8 Unattended person
K
Factors Contributing to Injury
None
Enter up to three contributing factors
Contributing factor (1)
Contributing factor (2)
Contributing factor (3)
L
Activity When Injured
1 Escaping
2 Rescue attempt
3 Fire control
4 Return to fire before control
5 Return to fire after control
6 Sleeping
7 Unable to act
8 Irrational act
0 Other
U Undetermined
M1
Location at Time of Incident
1 In area of origin and not involved
2 Not in area of origin & not involved
3 Not in area of origin, but involved
4 In area of origin and involved
U Undetermined
M2
General Location at Time of Injury
Check ONE box. If undetermined, leave blank and skip to Section N.
1 In area of fire origin
2 In building, but not in area
3 Outside, but not in area
Skip to Section N
Skip to Section M5
M3
Story at Start of Incident
Complete ONLY if injury occurred INSIDE
Story at START of incident
below grade
M4
Story Where Injury Occurred
Story where injury occurred, if different from M3
below grade
M5
Specific Location at Time of Injury
Complete ONLY if casualty NOT in area of origin
Specific location at time of injury
N
Primary Apparent Symptom
01 Smoke only, asphyxiation
11 Burns & smoke inhalation
12 Burns only
21 Cut, laceration
33 Strain or sprain
96 Shock
98 Pain only
Look up a code only if the symptom is NOT found above
Primary apparent symptom
O
Primary Area of Body Injured
1 Head
2 Neck & shoulder
3 Thorax
4 Abdomen
5 Spine
6 Upper extremities
7 Lower extremities
8 Internal
9 Multiple body parts
P
Disposition
Transported to emergency care facility
Remarks
Local option
NFIRS-4 Revision 11/17/98

A FDID ☆ | State ☆ | Incident Date (MM DD YYYY) ☆ | Station | Incident Number ☆ | Exposure ☆ | ☐ Delete ☐ Change

NFIRS - 5 Fire Service Casualty

B Injured Person Identification Number | 1 ☐ Male ☆ 2 ☐ Female | 1 ☐ Career 2 ☐ Volunteer

First Name | MI | Last Name | Suffix

C Casualty Number ☆ Casualty Number

D Age or Date of Birth ☆

Age (In years) OR Date of Birth (Month Day Year)

E Date & Time of Injury ☆ Midnight is 0000.

Date of Injury (Month Day Year) Time of Injury (Hour Minutes)

F Responses

Number of prior responses during past 24 hours

G1 Usual Assignment

1 ☐ Suppression
2 ☐ EMS
3 ☐ Prevention
4 ☐ Training
5 ☐ Maintenance
6 ☐ Communications
7 ☐ Administration
8 ☐ Fire investigation
0 ☐ Other

G2 Physical Condition Just Prior To Injury

1 ☐ Rested
2 ☐ Fatigued
4 ☐ Ill or injured
0 ☐ Other
U ☐ Undetermined

G3 Severity

1 ☐ Report only, including exposure
2 ☐ First aid only
3 ☐ Treated by physician (no lost time)
4 ☐ Moderate (lost time)
5 ☐ Severe (lost time)
6 ☐ Life threatening (lost time)
7 ☐ Death

G4 Taken To

1 ☐ Hospital
4 ☐ Doctor's office
5 ☐ Morgue/funeral home
6 ☐ Residence
7 ☐ Station or quarters
0 ☐ Other
N ☐ Not transported

G5 Activity at Time of Injury

Activity at time of injury

H1 Primary Apparent Symptom

Primary apparent symptom

H2 Primary Area of Body Injured

Primary injured body part or area

I1 Cause of Firefighter Injury

Cause of injury

I2 Factor Contributing to Injury

Contributing factor

I3 Object Involved in Injury

☐ None

Object involved in injury

J1 Where Injury Occurred

1 ☐ Enroute to FD location
2 ☐ At FD location
3 ☐ Enroute to incident scene
4 ☐ Enroute to medical facility
5 ☐ At scene in structure
6 ☐ At scene outside
7 ☐ At medical facility
8 ☐ Returning from incident
9 ☐ Returning from med facility
0 ☐ Other

J2 Story Where Injury Occurred

1 ☐ Check this box and enter the story if the injury occurred inside or on a structure

Story of injury ☐ Below grade

2 ☐ Injury occurred outside

J3 Specific Location Complete as applicable

65 ☐ In aircraft
64 ☐ In boat or ship or barge
63 ☐ In rail vehicle
61 ☐ In motor vehicle
54 ☐ In sewer
53 ☐ In tunnel
49 ☐ In structure
45 ☐ In attic
36 ☐ In water
35 ☐ In well
34 ☐ In ravine
33 ☐ In quarry or mine
32 ☐ In ditch or trench
31 ☐ In open pit
28 ☐ On steep grade
27 ☐ On fire escape/outside stairs
26 ☐ On vertical surface or ledge
25 ☐ On ground ladder
24 ☐ On aerial ladder or in basket
23 ☐ On roof
22 ☐ Outside at grade
00 ☐ Other

J4 Vehicle Type Complete ONLY if Specific Location code is >60

1 ☐ Suppression vehicle
2 ☐ EMS vehicle
3 ☐ Other FD vehicle
4 ☐ Non-FD vehicle

Remarks

If protective equipment failed and was a factor in this injury, please complete the other side of this form.

NFIRS-5 Revision 8/18/99

K1 Did protective equipment fail and contribute to the injury? Yes Y ☐ No N ☐

Please complete the remainder of this form ONLY if you answered YES.

Equipment Sequence Number ⌊__⌋

NFIRS - 5 Fire Service Casualty

K2 Protective Equipment Item

Head or Face Protection

- 11 ☐ Helmet
- 12 ☐ Full face protector
- 13 ☐ Partial protector
- 14 ☐ Goggles/eye protection
- 15 ☐ Hood
- 16 ☐ Ear protector
- 17 ☐ Neck protector
- 10 ☐ Other

Coat, shirt, or trousers

- 21 ☐ Protective coat
- 22 ☐ Protective trousers
- 23 ☐ Uniform shirt
- 24 ☐ Uniform t-shirt
- 25 ☐ Uniform trousers
- 26 ☐ Uniform coat or jacket
- 27 ☐ Overalls
- 28 ☐ Apron or gown
- 20 ☐ Other

Boots or Shoes

- 31 ☐ Knee length boots w/ steel baseplate & steel toes
- 32 ☐ Knee length boots w/ steel toes only
- 33 ☐ 3/4 length boots w/ steel baseplate & steel toes
- 34 ☐ 3/4 length boots w/ steel toes only
- 35 ☐ Boots without steel baseplate & steel toes
- 36 ☐ Safety shoes w/ steel baseplate & steel toes
- 37 ☐ Safety shoes w/ steel toes only
- 38 ☐ Non-safety shoes
- 30 ☐ Other

Respiratory Protection

- 41 ☐ SCBA (demand) open circuit
- 42 ☐ SCBA (positive pressure) open circuit
- 43 ☐ SCBA closed circuit
- 44 ☐ Not self-contained
- 45 ☐ Cartridge respirator
- 46 ☐ Dust or particle mask
- 40 ☐ Other

Hand Protection

- 51 ☐ Firefighter gloves w/ wristlets
- 52 ☐ Firefighter gloves without wristlets
- 53 ☐ Work gloves
- 54 ☐ Hazmat gloves
- 55 ☐ Medical gloves
- 50 ☐ Other

Special Equipment

- 61 ☐ Proximity suit for entry
- 62 ☐ Proximity suit for non-entry
- 63 ☐ Totally encapsulated, reusable chemical suit
- 64 ☐ Totally encapsulated, disposable chemical suit
- 65 ☐ Partially encapsulated, reusable chemical suit
- 66 ☐ Partially encapsulated, disposable chemical suit
- 67 ☐ Flash protection suit
- 68 ☐ Flight or jump suit
- 69 ☐ Brush suit
- 71 ☐ Exposure suit
- 72 ☐ Self-contained underwater breathing apparatus (SCUBA)
- 73 ☐ Life preserver
- 74 ☐ Life belt or ladder belt
- 75 ☐ Personal alert safety system (PASS)
- 76 ☐ Radio distress device
- 77 ☐ Personal lighting
- 78 ☐ Fire shelter or tent
- 79 ☐ Vehicle safety belt
- 70 ☐ Other

Was the failure of more than one item of protective equipment a factor in the injury? If so, complete an additional page of this form for each piece of failed equipment.

K3 Protective Equipment Problem

Check one box to indicate the main problem that occurred.

- 11 ☐ Burned
- 12 ☐ Melted
- 21 ☐ Fractured, cracked or broken
- 22 ☐ Punctured
- 23 ☐ Scratched
- 24 ☐ Knocked off
- 25 ☐ Cut or ripped
- 31 ☐ Trapped steam or hazardous gas
- 32 ☐ Insufficient insulation
- 33 ☐ Object fell in or onto equipment item
- 41 ☐ Failed under impact
- 42 ☐ Face piece or hose detached
- 43 ☐ Exhalation valve inoperative or damaged
- 44 ☐ Harness detached or separated
- 45 ☐ Regulator failed to operate
- 46 ☐ Regulator damaged by contact
- 47 ☐ Problem with admissions valve
- 48 ☐ Alarm failed to operate
- 49 ☐ Alarm damaged by contact
- 51 ☐ Supply cylinder or valve failed to operate
- 52 ☐ Supply cylinder/valve damaged by contact
- 53 ☐ Supply cylinder— insufficient air/oxygen
- 94 ☐ Did not fit properly
- 95 ☐ Not properly serviced or stored prior to use
- 96 ☐ Not used for designed purpose
- 97 ☐ Not used as recommended by manufacturer
- 00 ☐ Other equipment problem

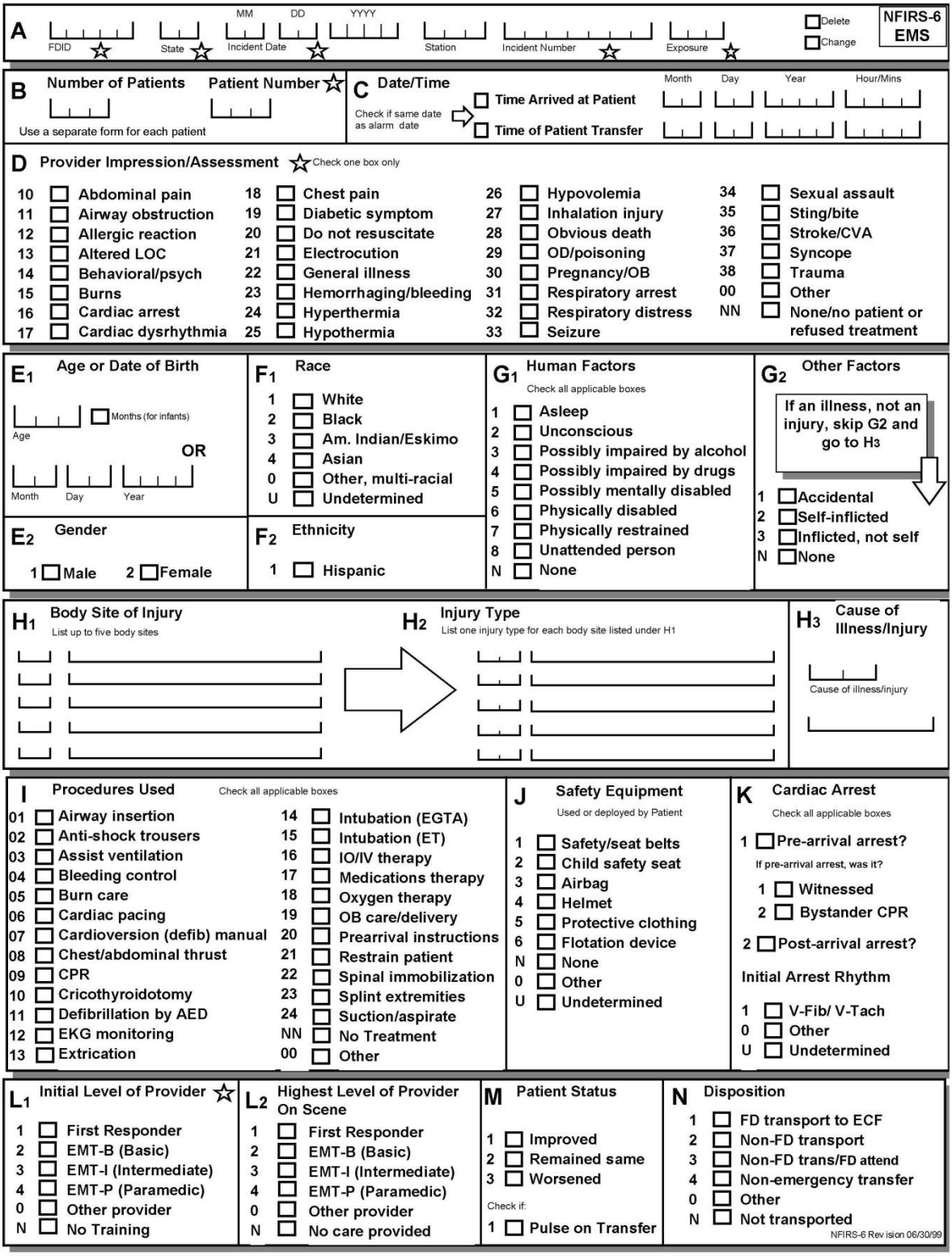
K4 Equipment Manufacturer, Model & Serial Number

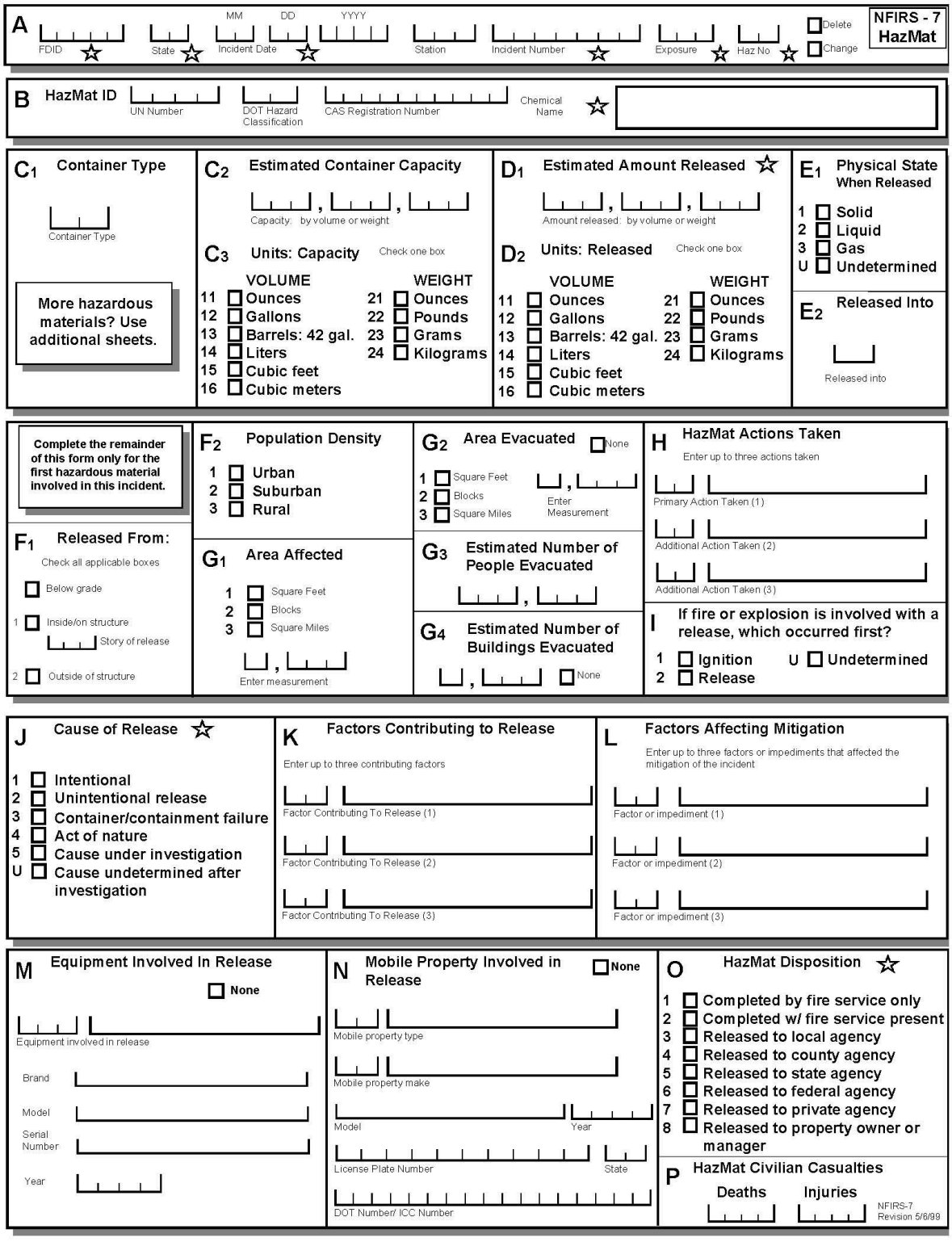
⌊_____⌋ Manufacturer

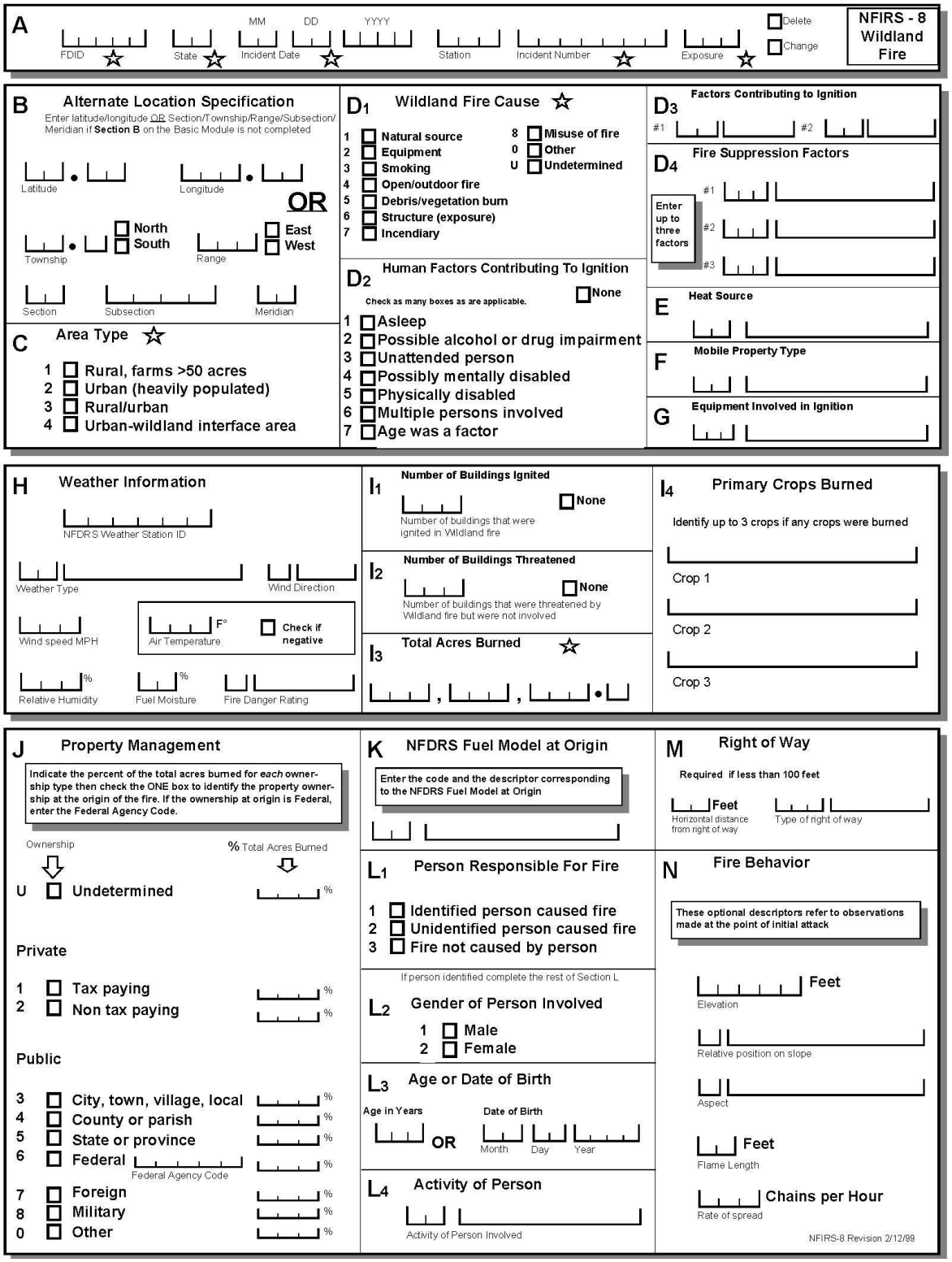
⌊_____⌋ Model

⌊_____⌋ Serial Number

NFIRS-5 Revision 6/25/99


A
FDID
State
MM
DD
YYYY
Incident Date
Station
Incident Number
Exposure
Delete
Change
NFIRS-6
EMS
B
Number of Patients
Patient Number
Use a separate form for each patient
C
Date/Time
Check if same date as alarm date
Time Arrived at Patient
Time of Patient Transfer
Month
Day
Year
Hour/Mins
D
Provider Impression/Assessment
Check one box only
10 Abdominal pain
11 Airway obstruction
12 Allergic reaction
13 Altered LOC
14 Behavioral/psych
15 Burns
16 Cardiac arrest
17 Cardiac dysrhythmia
18 Chest pain
19 Diabetic symptom
20 Do not resuscitate
21 Electrocution
22 General illness
23 Hemorrhaging/bleeding
24 Hyperthermia
25 Hypothermia
26 Hypovolemia
27 Inhalation injury
28 Obvious death
29 OD/poisoning
30 Pregnancy/OB
31 Respiratory arrest
32 Respiratory distress
33 Seizure
34 Sexual assault
35 Sting/bite
36 Stroke/CVA
37 Syncope
38 Trauma
00 Other
NN None/no patient or refused treatment
E1
Age or Date of Birth
Months (for infants)
Age
OR
Month
Day
Year
E2
Gender
1 Male
2 Female
F1
Race
1 White
2 Black
3 Am. Indian/Eskimo
4 Asian
0 Other, multi-racial
U Undetermined
F2
Ethnicity
1 Hispanic
G1
Human Factors
Check all applicable boxes
1 Asleep
2 Unconscious
3 Possibly impaired by alcohol
4 Possibly impaired by drugs
5 Possibly mentally disabled
6 Physically disabled
7 Physically restrained
8 Unattended person
N None
G2
Other Factors
If an illness, not an injury, skip G2 and go to H3
1 Accidental
2 Self-inflicted
3 Inflicted, not self
N None
H1
Body Site of Injury
List up to five body sites
H2
Injury Type
List one injury type for each body site listed under H1
H3
Cause of Illness/Injury
Cause of illness/injury
I
Procedures Used
Check all applicable boxes
01 Airway insertion
02 Anti-shock trousers
03 Assist ventilation
04 Bleeding control
05 Burn care
06 Cardiac pacing
07 Cardioversion (defib) manual
08 Chest/abdominal thrust
09 CPR
10 Cricothyroidotomy
11 Defibrillation by AED
12 EKG monitoring
13 Extrication
14 Intubation (EGTA)
15 Intubation (ET)
16 IO/IV therapy
17 Medications therapy
18 Oxygen therapy
19 OB care/delivery
20 Prearrival instructions
21 Restrain patient
22 Spinal immobilization
23 Splint extremities
24 Suction/aspirate
NN No Treatment
00 Other
J
Safety Equipment
Used or deployed by Patient
1 Safety/seat belts
2 Child safety seat
3 Airbag
4 Helmet
5 Protective clothing
6 Flotation device
N None
0 Other
U Undetermined
K
Cardiac Arrest
Check all applicable boxes
1 Pre-arrival arrest?
If pre-arrival arrest, was it?
1 Witnessed
2 Bystander CPR
2 Post-arrival arrest?
Initial Arrest Rhythm
1 V-Fib/ V-Tach
0 Other
U Undetermined
L1
Initial Level of Provider
1 First Responder
2 EMT-B (Basic)
3 EMT-I (Intermediate)
4 EMT-P (Paramedic)
0 Other provider
N No Training
L2
Highest Level of Provider On Scene
1 First Responder
2 EMT-B (Basic)
3 EMT-I (Intermediate)
4 EMT-P (Paramedic)
0 Other provider
N No care provided
M
Patient Status
1 Improved
2 Remained same
3 Worsened
Check if:
1 Pulse on Transfer
N
Disposition
1 FD transport to ECF
2 Non-FD transport
3 Non-FD trans/FD attend
4 Non-emergency transfer
0 Other
N Not transported
NFIRS-6 Revision 06/30/99


A
FDID
State
MM
DD
YYYY
Incident Date
Station
Incident Number
Exposure
Haz No
Delete
Change
NFIRS - 7
HazMat
B HazMat ID
UN Number
DOT Hazard Classification
CAS Registration Number
Chemical Name
C1 Container Type
Container Type
More hazardous materials? Use additional sheets.
C2 Estimated Container Capacity
Capacity: by volume or weight
C3 Units: Capacity
Check one box
VOLUME
11 Ounces
12 Gallons
13 Barrels: 42 gal.
14 Liters
15 Cubic feet
16 Cubic meters
WEIGHT
21 Ounces
22 Pounds
23 Grams
24 Kilograms
D1 Estimated Amount Released
Amount released: by volume or weight
D2 Units: Released
Check one box
VOLUME
11 Ounces
12 Gallons
13 Barrels: 42 gal.
14 Liters
15 Cubic feet
16 Cubic meters
WEIGHT
21 Ounces
22 Pounds
23 Grams
24 Kilograms
E1 Physical State When Released
1 Solid
2 Liquid
3 Gas
U Undetermined
E2 Released Into
Released into
Complete the remainder of this form only for the first hazardous material involved in this incident.
F1 Released From:
Check all applicable boxes
Below grade
1 Inside/on structure
Story of release
2 Outside of structure
F2 Population Density
1 Urban
2 Suburban
3 Rural
G1 Area Affected
1 Square Feet
2 Blocks
3 Square Miles
Enter measurement
G2 Area Evacuated
None
1 Square Feet
2 Blocks
3 Square Miles
Enter Measurement
G3 Estimated Number of People Evacuated
G4 Estimated Number of Buildings Evacuated
None
H HazMat Actions Taken
Enter up to three actions taken
Primary Action Taken (1)
Additional Action Taken (2)
Additional Action Taken (3)
I If fire or explosion is involved with a release, which occurred first?
1 Ignition
2 Release
U Undetermined
J Cause of Release
1 Intentional
2 Unintentional release
3 Container/containment failure
4 Act of nature
5 Cause under investigation
U Cause undetermined after investigation
K Factors Contributing to Release
Enter up to three contributing factors
Factor Contributing To Release (1)
Factor Contributing To Release (2)
Factor Contributing To Release (3)
L Factors Affecting Mitigation
Enter up to three factors or impediments that affected the mitigation of the incident
Factor or impediment (1)
Factor or impediment (2)
Factor or impediment (3)
M Equipment Involved In Release
None
Equipment involved in release
Brand
Model
Serial Number
Year
N Mobile Property Involved in Release
None
Mobile property type
Mobile property make
Model
Year
License Plate Number
State
DOT Number/ ICC Number
O HazMat Disposition
1 Completed by fire service only
2 Completed w/ fire service present
3 Released to local agency
4 Released to county agency
5 Released to state agency
6 Released to federal agency
7 Released to private agency
8 Released to property owner or manager
P HazMat Civilian Casualties
Deaths
Injuries
NFIRS-7
Revision 5/6/99


A
FDID
State
MM
DD
YYYY
Incident Date
Station
Incident Number
Exposure
Delete
Change
NFIRS - 8 Wildland Fire
B
Alternate Location Specification
Enter latitude/longitude OR Section/Township/Range/Subsection/ Meridian if Section B on the Basic Module is not completed
Latitude
Longitude
OR
North
South
East
West
Township
Range
Section
Subsection
Meridian
C
Area Type
1 Rural, farms >50 acres
2 Urban (heavily populated)
3 Rural/urban
4 Urban-wildland interface area
D1
Wildland Fire Cause
1 Natural source
2 Equipment
3 Smoking
4 Open/outdoor fire
5 Debris/vegetation burn
6 Structure (exposure)
7 Incendiary
8 Misuse of fire
0 Other
U Undetermined
D2
Human Factors Contributing To Ignition
Check as many boxes as are applicable.
None
1 Asleep
2 Possible alcohol or drug impairment
3 Unattended person
4 Possibly mentally disabled
5 Physically disabled
6 Multiple persons involved
7 Age was a factor
D3
Factors Contributing to Ignition
#1
#2
D4
Fire Suppression Factors
Enter up to three factors
#1
#2
#3
E
Heat Source
F
Mobile Property Type
G
Equipment Involved in Ignition
H
Weather Information
NFDRS Weather Station ID
Weather Type
Wind Direction
Wind speed MPH
Air Temperature
Check if negative
Relative Humidity
Fuel Moisture
Fire Danger Rating
I1
Number of Buildings Ignited
None
Number of buildings that were ignited in Wildland fire
I2
Number of Buildings Threatened
None
Number of buildings that were threatened by Wildland fire but were not involved
I3
Total Acres Burned
I4
Primary Crops Burned
Identify up to 3 crops if any crops were burned
Crop 1
Crop 2
Crop 3
J
Property Management
Indicate the percent of the total acres burned for each ownership type then check the ONE box to identify the property ownership at the origin of the fire. If the ownership at origin is Federal, enter the Federal Agency Code.
Ownership
% Total Acres Burned
U Undetermined
Private
1 Tax paying
2 Non tax paying
Public
3 City, town, village, local
4 County or parish
5 State or province
6 Federal
Federal Agency Code
7 Foreign
8 Military
0 Other
K
NFDRS Fuel Model at Origin
Enter the code and the descriptor corresponding to the NFDRS Fuel Model at Origin
M
Right of Way
Required if less than 100 feet
Feet
Horizontal distance from right of way
Type of right of way
L1
Person Responsible For Fire
1 Identified person caused fire
2 Unidentified person caused fire
3 Fire not caused by person
If person identified complete the rest of Section L
L2
Gender of Person Involved
1 Male
2 Female
L3
Age or Date of Birth
Age in Years
OR
Date of Birth
Month
Day
Year
L4
Activity of Person
Activity of Person Involved
N
Fire Behavior
These optional descriptors refer to observations made at the point of initial attack
Feet
Elevation
Relative position on slope
Aspect
Feet
Flame Length
Chains per Hour
Rate of spread
NFIRS-8 Revision 2/12/99

A

FDID ☆ | State ☆ | Incident Date (MM DD YYYY) ☆ | Station | Incident Number ☆ | Exposure ☆ | ☐ Delete ☐ Change

NFIRS - 9 Apparatus or Resources

B Apparatus or Resource ☆ (Use codes listed below)	Dates and Times (Check if same date as alarm date) Month Day Year Hours/Mins	Sent [X]	Number of People ☆	Use ☆ (Check ONE box for each apparatus to indicate its main use at the incident.)	Actions Taken
1 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
2 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
3 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
4 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
5 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
6 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
7 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
8 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	
9 ID / Type	Dispatch / Arrival / Clear	☐		☐ Suppression ☐ EMS ☐ Other	

Type of Apparatus or Resource

Ground Fire Suppression

- 11 Engine
- 12 Truck or aerial
- 13 Quint
- 14 Tanker & pumper combination
- 16 Brush truck
- 17 ARF (Aircraft Rescue and Firefighting)
- 10 Ground fire suppression, other

Heavy Ground Equipment

- 21 Dozer or plow
- 22 Tractor
- 24 Tanker or tender
- 20 Heavy equipment, other

Aircraft

- 41 Aircraft: fixed wing tanker
- 42 Helitanker
- 43 Helicopter
- 40 Aircraft, other

Marine Equipment

- 51 Fire boat with pump
- 52 Boat, no pump
- 50 Marine apparatus, other

Support Equipment

- 61 Breathing apparatus support
- 62 Light and air unit
- 60 Support apparatus, other

Medical & Rescue

- 71 Rescue unit
- 72 Urban search & rescue unit
- 73 High angle rescue unit
- 75 BLS unit
- 76 ALS unit
- 70 Medical and rescue unit, other

Other

- 91 Mobile command post
- 92 Chief officer car
- 93 HazMat unit
- 94 Type 1 hand crew
- 95 Type 2 hand crew
- 99 Privately owned vehicle
- 00 Other apparatus/resource

More apparatus? Use additional sheets.

NN None
UU Undetermined

NFIRS-9 Revision 11/17/98

A FDID ☆ | State ☆ | Incident Date (MM DD YYYY) ☆ | Station | Incident Number ☆ | Exposure ☆ | ☐ Delete ☐ Change | **NFIRS - 10 Personnel**

B Apparatus or Resource ☆	Dates and Times (Check if same date as alarm date) Month Day Year Hours/Mins	Sent [X]	Number of People ☆	Use ☆ Check ONE box for each apparatus to indicate its main use at the incident.	Actions Taken List up to 4 actions for each apparatus and each personnel.
1 ID Type	Dispatch ☐ Arrival ☐ Clear ☐	Sent ☐	#	☐ Suppression ☐ EMS ☐ Other	

Personnel ID ☆	Name	Rank or Grade	Attend [X]	Action Taken	Action Taken	Action Taken	Action Taken
			☐				
			☐				
			☐				
			☐				
			☐				
			☐				

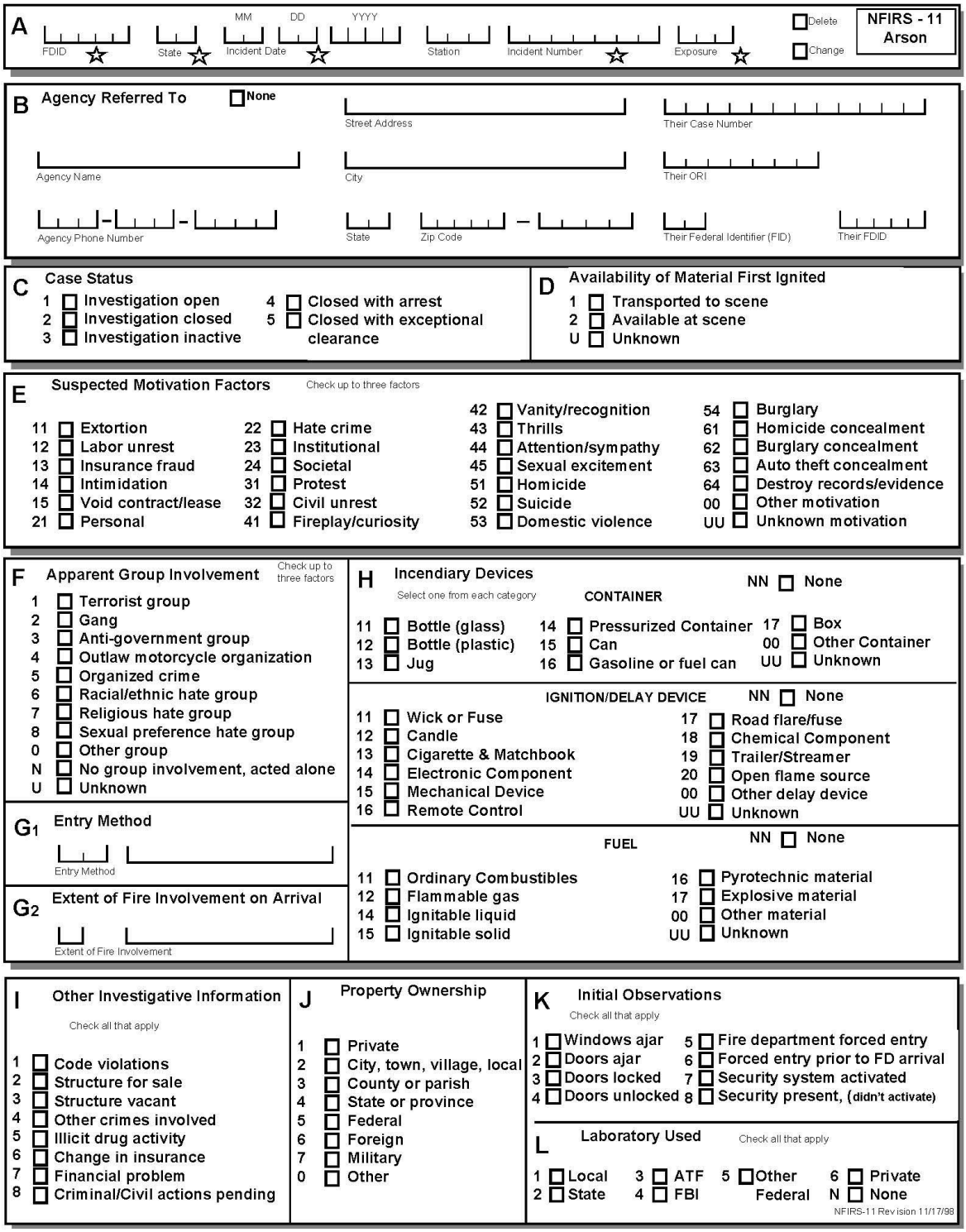
2 ID Type	Dispatch ☐ Arrival ☐ Clear ☐	Sent ☐	#	☐ Suppression ☐ EMS ☐ Other	

Personnel ID ☆	Name	Rank or Grade	Attend [X]	Action Taken	Action Taken	Action Taken	Action Taken
			☐				
			☐				
			☐				
			☐				
			☐				
			☐				

3 ID Type	Dispatch ☐ Arrival ☐ Clear ☐	Sent ☐	#	☐ Suppression ☐ EMS ☐ Other	

Personnel ID ☆	Name	Rank or Grade	Attend [X]	Action Taken	Action Taken	Action Taken	Action Taken
			☐				
			☐				
			☐				
			☐				
			☐				
			☐				

NFIRS-10 Revision 11/17/98



A
FDID
State
MM Incident Date
DD
YYYY
Station
Incident Number
Exposure
Delete
Change
NFIRS - 11 Arson

B Agency Referred To None
Street Address
Their Case Number
Agency Name
City
Their ORI
Agency Phone Number
State
Zip Code
Their Federal Identifier (FID)
Their FDID

C Case Status
1 Investigation open
2 Investigation closed
3 Investigation inactive
4 Closed with arrest
5 Closed with exceptional clearance

D Availability of Material First Ignited
1 Transported to scene
2 Available at scene
U Unknown

E Suspected Motivation Factors
Check up to three factors
11 Extortion
12 Labor unrest
13 Insurance fraud
14 Intimidation
15 Void contract/lease
21 Personal
22 Hate crime
23 Institutional
24 Societal
31 Protest
32 Civil unrest
41 Fireplay/curiosity
42 Vanity/recognition
43 Thrills
44 Attention/sympathy
45 Sexual excitement
51 Homicide
52 Suicide
53 Domestic violence
54 Burglary
61 Homicide concealment
62 Burglary concealment
63 Auto theft concealment
64 Destroy records/evidence
00 Other motivation
UU Unknown motivation

F Apparent Group Involvement
Check up to three factors
1 Terrorist group
2 Gang
3 Anti-government group
4 Outlaw motorcycle organization
5 Organized crime
6 Racial/ethnic hate group
7 Religious hate group
8 Sexual preference hate group
0 Other group
N No group involvement, acted alone
U Unknown

G1 Entry Method
Entry Method

G2 Extent of Fire Involvement on Arrival
Extent of Fire Involvement

H Incendiary Devices
Select one from each category
NN None

CONTAINER
11 Bottle (glass)
12 Bottle (plastic)
13 Jug
14 Pressurized Container
15 Can
16 Gasoline or fuel can
17 Box
00 Other Container
UU Unknown

IGNITION/DELAY DEVICE
NN None
11 Wick or Fuse
12 Candle
13 Cigarette & Matchbook
14 Electronic Component
15 Mechanical Device
16 Remote Control
17 Road flare/fuse
18 Chemical Component
19 Trailer/Streamer
20 Open flame source
00 Other delay device
UU Unknown

FUEL
NN None
11 Ordinary Combustibles
12 Flammable gas
14 Ignitable liquid
15 Ignitable solid
16 Pyrotechnic material
17 Explosive material
00 Other material
UU Unknown

I Other Investigative Information
Check all that apply
1 Code violations
2 Structure for sale
3 Structure vacant
4 Other crimes involved
5 Illicit drug activity
6 Change in insurance
7 Financial problem
8 Criminal/Civil actions pending

J Property Ownership
1 Private
2 City, town, village, local
3 County or parish
4 State or province
5 Federal
6 Foreign
7 Military
0 Other

K Initial Observations
Check all that apply
1 Windows ajar
2 Doors ajar
3 Doors locked
4 Doors unlocked
5 Fire department forced entry
6 Forced entry prior to FD arrival
7 Security system activated
8 Security present, (didn't activate)

L Laboratory Used
Check all that apply
1 Local
2 State
3 ATF
4 FBI
5 Other Federal
6 Private
N None

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A FDID ☆ | State ☆ | Incident Date (MM DD YYYY) ☆ | Station | Incident Number ☆ | Exposure ☆ | ☐ Delete ☐ Change

NFIRS - 11 Juvenile Firesetter

Complete this section if the person involved in the ignition of the fire was a child or Juvenile under the age of 18

M1 Subject Number

Subject Number

M2 Age or Date of Birth

Age (in years)

OR

Month Day Year

M3 Gender

1 ☐ Male 2 ☐ Female

M4 Race

1 ☐ White
2 ☐ Black
3 ☐ Am. Indian, Eskimo
4 ☐ Asian
0 ☐ Other, multi-racial
U ☐ Undetermined

M5 Ethnicity

1 ☐ Hispanic

M6 Family Type

1 ☐ Single parent
2 ☐ Foster parent(s)
3 ☐ Two parent family
4 ☐ Extended family
N ☐ No family unit
0 ☐ Other family type
U ☐ Unknown

M7 Motivation/Risk Factors Check only one of codes 1-3 and then all others that apply

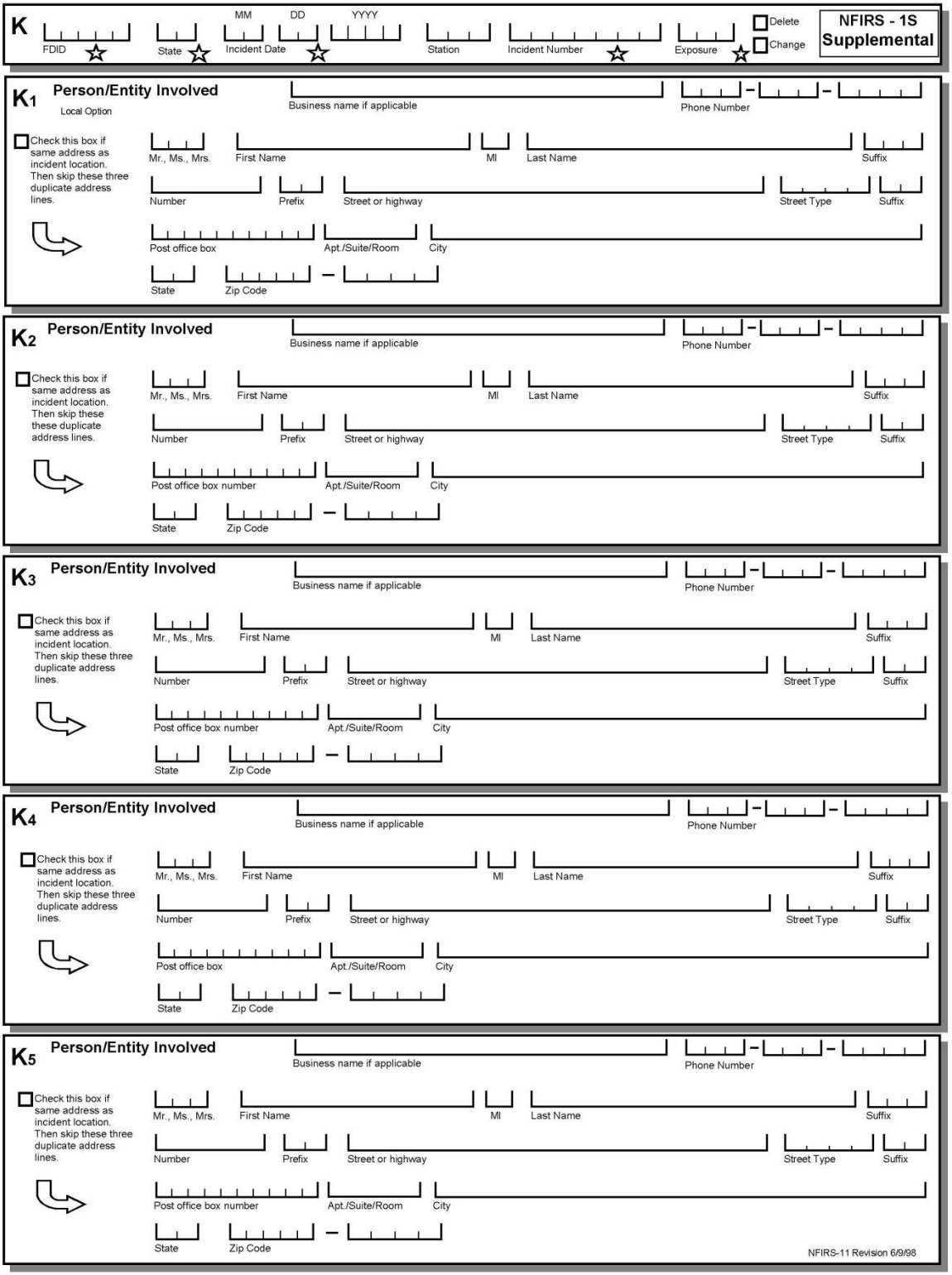
1 ☐ Mild curiosity about fire
2 ☐ Moderate curiosity about fire
3 ☐ Extreme curiosity about fire

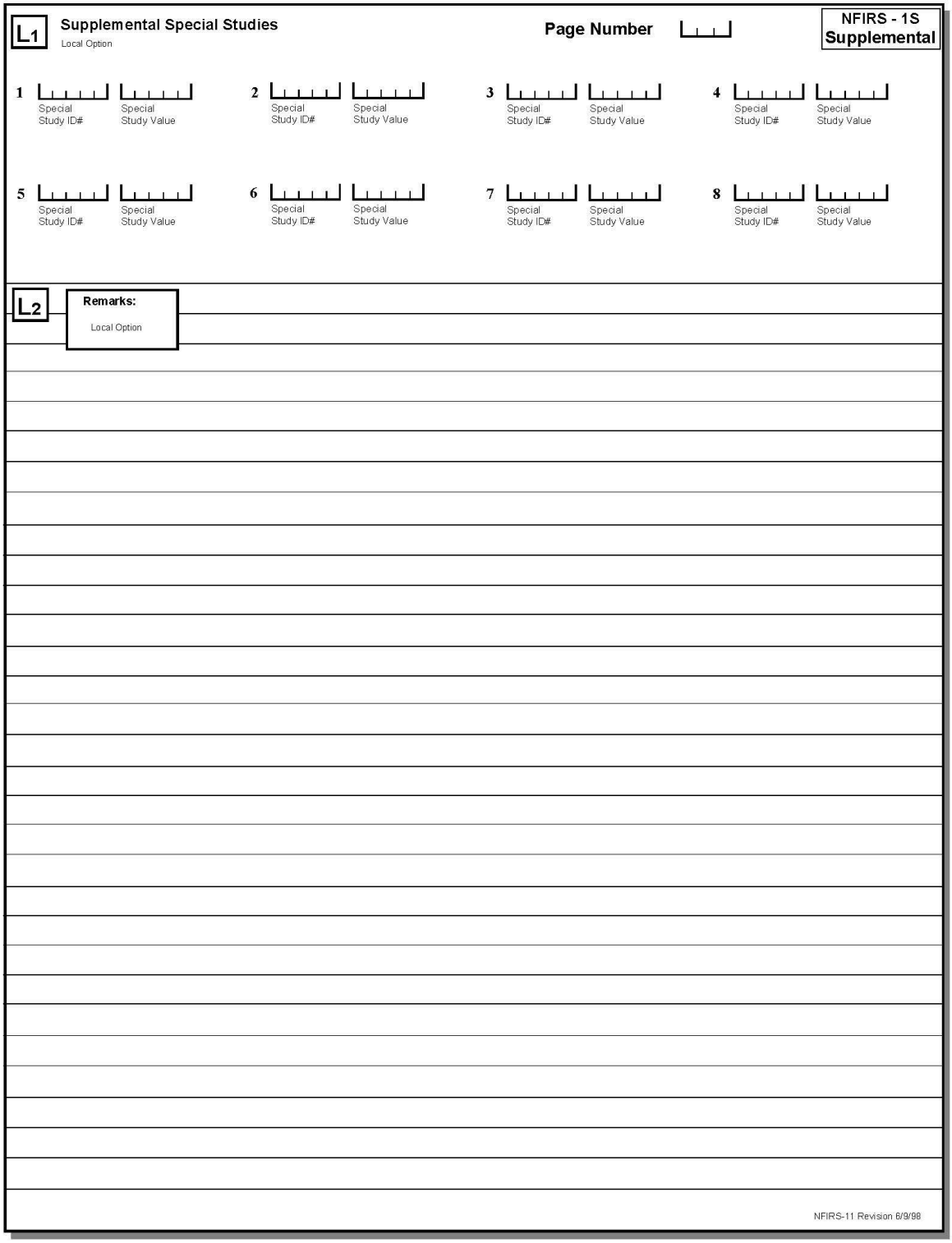
4 ☐ Diagnosed (or suspected) ADD/ADHD
5 ☐ History of trouble outside school
6 ☐ History of stealing or shoplifting
7 ☐ History of physically assaulting others
8 ☐ History of fireplay or firesetting
9 ☐ Transiency
0 ☐ Other
U ☐ Unknown

M8 Disposition of Person Under 18

1 ☐ Handled within department
2 ☐ Released to parent/guardian
3 ☐ Referred to other authority
4 ☐ Referred to treatment program
5 ☐ Arrested, charged as adult
6 ☐ Referred to firesetter intervention program
0 ☐ Other
U ☐ Unknown

N Remarks (local use)

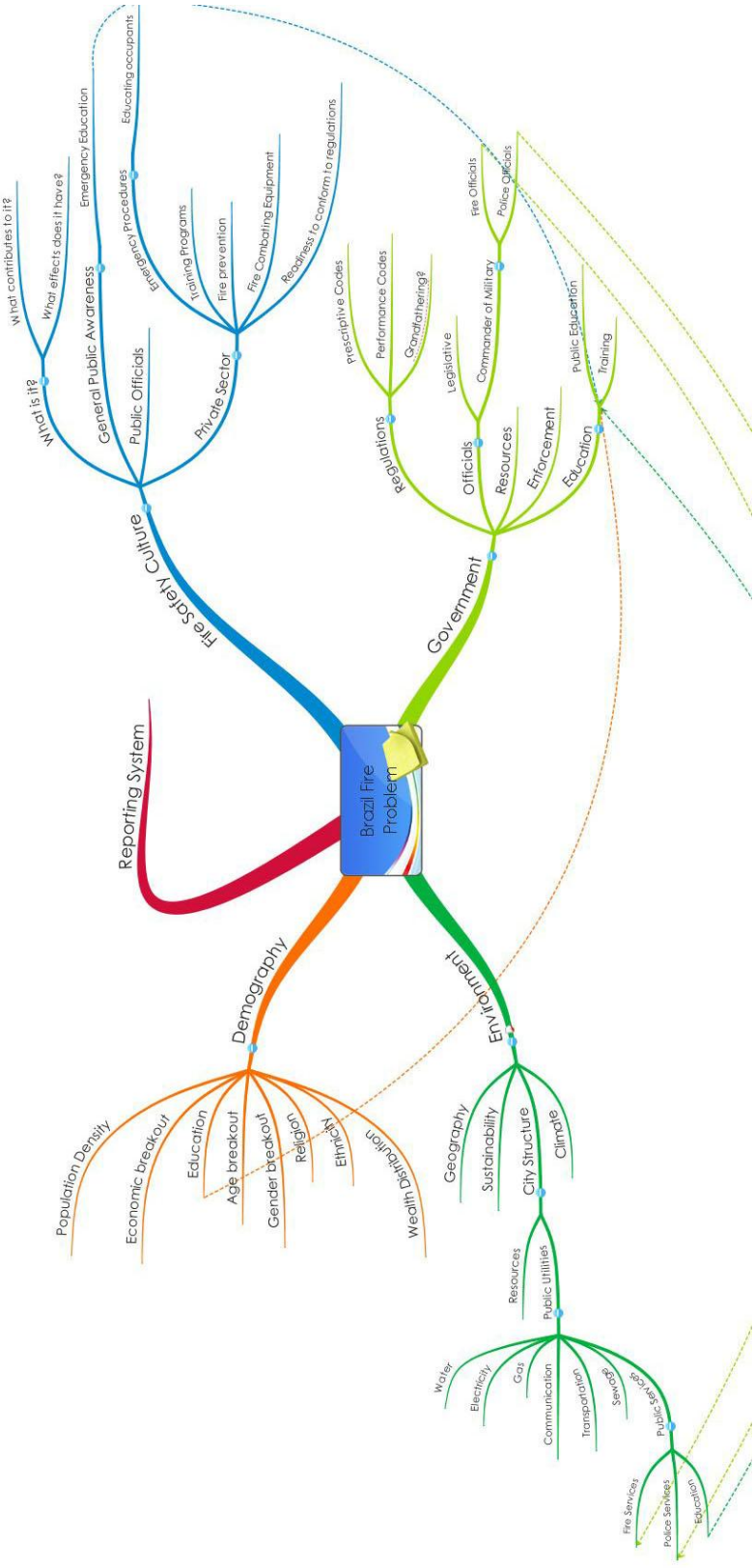

K
FDID
State
MM
DD
YYYY
Incident Date
Station
Incident Number
Exposure
Delete
Change
NFIRS - 1S
Supplemental
K1 Person/Entity Involved
Local Option
Business name if applicable
Phone Number
Check this box if same address as incident location. Then skip these three duplicate address lines.
Mr., Ms., Mrs.
First Name
MI
Last Name
Suffix
Number
Prefix
Street or highway
Street Type
Suffix
Post office box
Apt./Suite/Room
City
State
Zip Code
K2 Person/Entity Involved
Business name if applicable
Phone Number
Check this box if same address as incident location. Then skip these these duplicate address lines.
Mr., Ms., Mrs.
First Name
MI
Last Name
Suffix
Number
Prefix
Street or highway
Street Type
Suffix
Post office box number
Apt./Suite/Room
City
State
Zip Code
K3 Person/Entity Involved
Business name if applicable
Phone Number
Check this box if same address as incident location. Then skip these three duplicate address lines.
Mr., Ms., Mrs.
First Name
MI
Last Name
Suffix
Number
Prefix
Street or highway
Street Type
Suffix
Post office box number
Apt./Suite/Room
City
State
Zip Code
K4 Person/Entity Involved
Business name if applicable
Phone Number
Check this box if same address as incident location. Then skip these three duplicate address lines.
Mr., Ms., Mrs.
First Name
MI
Last Name
Suffix
Number
Prefix
Street or highway
Street Type
Suffix
Post office box
Apt./Suite/Room
City
State
Zip Code
K5 Person/Entity Involved
Business name if applicable
Phone Number
Check this box if same address as incident location. Then skip these three duplicate address lines.
Mr., Ms., Mrs.
First Name
MI
Last Name
Suffix
Number
Prefix
Street or highway
Street Type
Suffix
Post office box number
Apt./Suite/Room
City
State
Zip Code
NFIRS-11 Revision 6/9/98


L1
Supplemental Special Studies
Local Option
Page Number
NFIRS - 1S
Supplemental
1 Special Study ID# Special Study Value
2 Special Study ID# Special Study Value
3 Special Study ID# Special Study Value
4 Special Study ID# Special Study Value
5 Special Study ID# Special Study Value
6 Special Study ID# Special Study Value
7 Special Study ID# Special Study Value
8 Special Study ID# Special Study Value
L2
Remarks:
Local Option
NFIRS-11 Revision 6/9/98

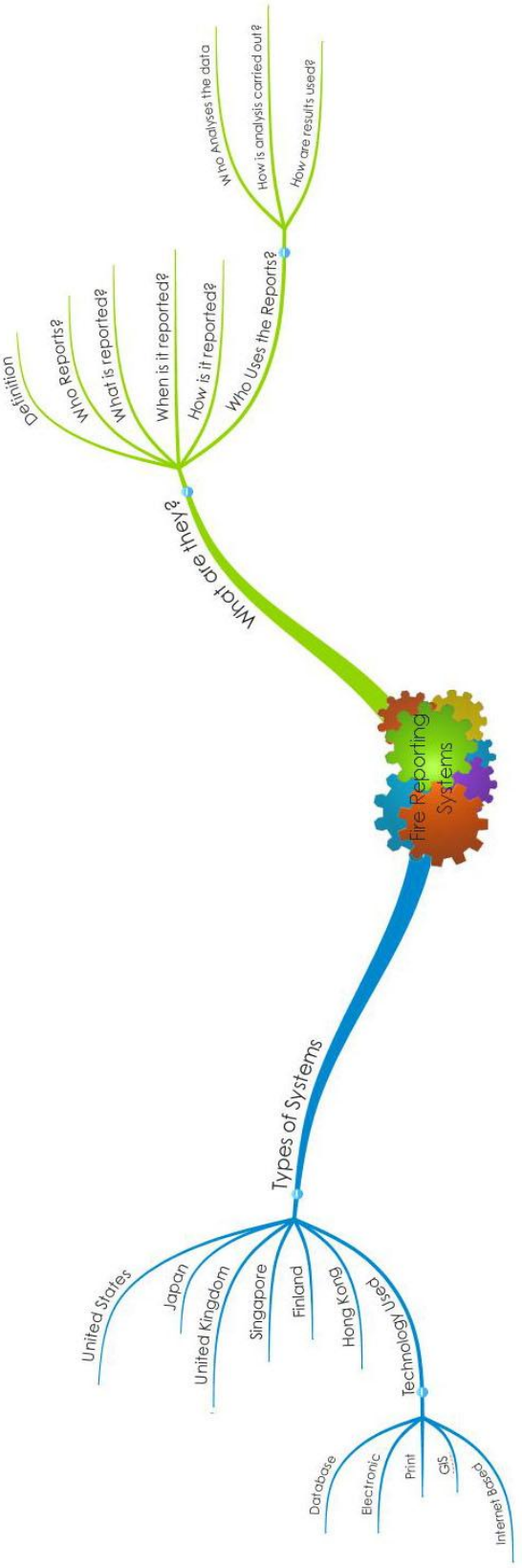
8.8 Appendix I

S/No	Designation	Rank/Name
1	Commissioner	Comr Eric Yap
2	Senior Director (Emergency Services)	-
3	Senior Director (Corporate Services)	COL Chong Hoi Hung
4	Director Logistics Department	COL Chin Lai Fong
5	Director Fire Safety & Shelter Department	MR Boo Geok Kwang
6	Director Operations Department	COL Anwar Bin Abdullah
7	Director Hazmat Department	COL Francis Ng
8	Director Manpower Department	Ms Wong Puy Mun
9	Director Training Department	COL Yap Kok Boon
10	Director Public Affairs Department	COL Yazid Abdullah
11	Director Technology Department	Mr Jeganathan Ramasamy
12	Director Medical Department / Chief Medical Officer	LTC (Dr) Poon Beng Hoong
13	Director Finance Department	Mr Ivan Chua
14	Director Service Excellence Department	LTC Ng Chee Kiang
15	Director Planning & Corporate Department	LTC Yong Meng Wah
16	Director National Service Personnel Department	LTC Lee Bee Hong
17	Director Central Enforcement Department	LTC Lian Wee Teck
18	Commander Service Support Unit	MAJ Ng Soo Beng

8.9 Appendix J



8.10 Appendix K



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