

First Progressive Report

EMERGENCY AND EVACUATION SYSTEMS FOR THE RÍO PIEDRAS TUNNEL

By

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December 2, 2000

Executive Summary

I. Introduction

Tren Urbano (TU) public and employees security is a topic that concerns the planners as well as its future passengers. The Emergency and Evacuation Systems are security components necessary to develop to ensure the TU use. These systems will provide a reliable transportation system and the users are going to feel comfortable and secure with it. The research is focused on the *Río Piedras Subterranean Station*.

A. Station Description

The *Río Piedras Station* will have a platform in the mezzanine level and will be divided in three (3) levels. Two of the station entrances will be located in the first level. One of them will have access to 'Plaza del Recreo' in the Ponce de León Avenue intersection with Arzuaga Street. The second entrance will be located in the intersection of the Ponce de León Avenue and the Robles Street.

B. Problem Statement

The Emergency and Evacuation Systems design is required by the Fire Department and other agencies for the use of any facility. The *Río Piedras Station* needs both systems before the *Tren Urbano's* aperture.

C. Justification

At this moment neither the Emergency nor the Evacuation System has been developed and because of the TU aperture proximity, it is necessary to design them. In addition, both systems can be use as a guide for the development of these systems in some of the TU future stations.

II. Objectives

- To develop an emergency procedure plan in which, detailed information about the agencies that will participate and their specific actions will be presented.
- Create an effective mechanism to evacuate the train station in a secure and orderly way to ensure that lives can be saved during an emergency.
- Plan and develop the emergency plan procedure to obtain an orderly and secure response.
- Determine how the station can return to its normal functions in the shortest period.

III. Progress Done

The progress done until this moment is the compilation of the necessary information for the development of the Emergency and Evacuation Systems. This information is related with the classification of the emergency situations, the Emergency and Evacuation Systems requirements, standards, and general models. The *Río Piedras Station* detailed drawings were obtained and they are going to be use for the development of the Evacuation System. Also, general recommendations were developed based on the railroad accidents reports and emergency situations occurred in Puerto Rico. This is going to be use as the model for the development of the systems.

A. General Evacuation Plan

1. TU users and employees shall evacuate the facilities using the designated exits.

2. TU users and employees shall be located in the designated exterior areas.
3. TU users and employees shall stay in the designated area not interfering with the emergency agencies labor until it is notify that they can leave the area. Management personnel shall verify their employees to determine if there is someone left inside the building.

B. Fire Emergency Procedure

1. Inform the Fire Department.
2. Activate Security personnel to perform their duties in the designated areas.
3. Evacuate the area.
4. The area coordinator should report the area status to the general manager.
5. Depending on the situation, the general coordinator will call other emergency agencies and will evacuate the entire area.
6. Emergency routes, exits, and stairs are going to be use during the evacuation.

C. Earthquake Emergency Procedure

1. Stay calm.
2. Look for protection inside the building to hide yourself from falling objects.
3. Do not try to evacuate the facilities, because it is possible that you could stay confine using elevators or stairs.
4. Stay away from crystal objects.
5. Do not try to light a candle, cigarette, because it is possible that an escape from a flammable gas has occurred.
6. After the earthquake is over, evacuate the facilities using the evacuation plan and get away from trees and light posts. Search for open areas.
7. Lying down (face down) is the best alternative for this type of situation.
8. Do not go back inside the building.
9. Follow the emergency plan and emergency personnel instructions.

The other topics that were developed are the following: emergency communication systems, equipment, and signal. Also, the employees' responsibilities, their trainings, information about the security zones, drills, recovery, and maintenance were topics that are part of this First Progressive Report.

Some of the General Recommendations are the following:

1. Any fire magnitude should be considered seriously.
2. If it is possible, alert the employees inside the cars before an accident (crash) occurs.
3. Consider that fire department cars are big and slow.
4. Locate facilities near the station were the users can be place if an emergency situation occurs.
5. Communication equipment and between agencies, emergency lighting, training, and evacuation routes information are really important.
6. Use direct phone lines.
7. Use an efficient power system – batteries, electrical, and fuel system.
8. Have computer access to car drawings, seating configuration layout, emergency exits, doors, and windows.
9. Drill with emergency agencies to verify communication system and make changes to the evacuation system whenever it is necessary.
10. Develop the shutdown and startup procedures.
11. Verify if the egress provision for the evacuation are adequate.
12. Ensure that egress routes can be followed in the dark or in smoke.

II. Conclusions

The designing of the Emergency and Evacuation Systems is going to be based on the requirements and standards compiled until this moment. Helpful tools for the development of the systems are the checklists. By using these checklists it is going to be possible to verify that every aspect is included in each system.

Other concepts that are going to be consider for the systems' development are the limitations in Puerto Rico that were present in past emergency situations and the handicaps' needs. The development of the Evacuation System is going to be based on the station's drawings and on additional information that is related with the way that this system works on another subterranean stations.



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I. Introduction

Tren Urbano (TU) public and employees security is a topic that concerns the planners as well as its future passengers. The Emergency and Evacuation Systems are security components necessary to develop to ensure the TU use. TU is an innovator transportation system in our island. That is why the designing of the systems already mentioned is necessary. These systems will provide a reliable transportation system and the users are going to feel comfortable and secure with it. At the same time, they will protect the property and environment, and will help to restore normal operations if an accident occurs.

The research is focused on the *Río Piedras Subterranean Station*.

A. Station Description

Tren Urbano's stage one¹ possesses two subterranean stations: *Río Piedras Station* and *Universidad Station*. Both stations are aligned with Ponce de León Avenue.

The *Río Piedras Station* (reference Figure 2) will have a platform in the mezzanine level and will be divided in three (3) levels. Two of the station entrances will be located in the first level. One of them will have access to 'Plaza del Recreo' in



Figure 2

the Ponce de León Avenue intersection with Arzuaga Street. The second entrance will be located in the intersection of the Ponce de León Avenue and the Robles Street.

B. Actual Situation

In the actuality, the *Río Piedras Station* is under construction. Its design has considered certain characteristics such as the corridors' wide, users accessibility, and additional information, which will be use for this research development.

C. Problem Statement

The Emergency and Evacuation Systems design is required by the Fire Department and other agencies for the use of any facility. The *Río Piedras Station* needs both systems before the *Tren Urbano's* aperture.



Figure 1

¹ Use as reference figure one to view *Tren Urbano's* stage one



D. Justification

At this moment neither the Emergency nor the Evacuation System has been developed and because of the TU aperture proximity, it is necessary to design them. In addition, both systems can be use as a guide for the development of these systems in some of the TU future stations.

II. Objectives

- To develop an emergency procedure plan in which, detailed information about the agencies that will participate and their specific actions will be presented.
- Create an effective mechanism to evacuate the train station in a secure and orderly way to ensure that lives can be saved during an emergency.
- Plan and develop the emergency plan procedure to obtain an orderly and secure response.
- Determine how the station can return to its normal functions in the shortest period.

III. General Background

Emergency situations are those situations in which life or facilities are in serious danger. These situations occur unexpectedly. They can be a result of natural and/or human causes. Some emergency situation examples are fires, explosions, and earthquakes. An emergency preparation includes the emergency system planning, practice, evaluation, and, if it is necessary, corrective actions.

Types of Emergencies²

1. Fire and/or smoke on a train or in any other part of the system
2. Fire and/or smoke adjoining or adjacent to the system that threatens the system or disrupts service
3. Collision and/or derailment involving one or more cars
4. Loss of electric power resulting in a stalled trains and/or loss of illumination
5. Evacuation of passengers from a train under adverse conditions
6. Panic of passengers
7. Disabled and/or stalled trains under adverse conditions
8. Serious flooding
9. Structural collapse or threat of imminent collapse that threatens system
10. Seepage of flammable, toxic or irritating products into system
11. Serious vandalism or other criminal acts
12. Emergency medical attention required by passengers

² This information is from the *Tren Urbano* Design Criteria



13. Extreme weather conditions causing disruption of service
14. Gas in a tunnel or cross-passage
15. Gas in a station ancillary room
16. Hurricanes
17. Earthquakes

Planning for each emergency situation will require many of the same considerations but some details will change.

The Emergency Response Plan should include:

1. Date adopted, reviewed, and revised
2. Statements of policy, purpose, scope, and definitions
3. Identification of participating agencies, top officials, and signatures of executives signing for each agency
4. Safety procedures during emergency operations
5. Purpose and operation of the Operation Control Center in an emergency
6. The requirements, purpose, and operation of radio and telephone communications at the Operation Control Center, at all stations and access points to the underground facilities, and at intermediate points throughout tunnels.
7. Details of the type, amount, location, and operating procedures of Emergency Management Panels to include fire detection, fire protection, fire extinguishing equipment, exit, and fan facilities.
8. Emergency procedure for postulated incidents with identification of agency in command.
9. Maps and plans of complex areas of the system such as long mountain tunnels and multilevel stations at Emergency Management Panels, Operation Control Center, and graphic at stations.
10. List of each Fire/Life Safety Committee member with their responsibilities during an emergency
11. Escape routes access
12. Information about the emergency equipment location and access

The Emergency System should describe:

1. Emergencies procedures for each emergency situation
2. Agencies coordination plans and their phone numbers
3. Responsibilities of each employee (in detail and clearly/explicit) and an organization chart
4. Emergency equipment and its location
5. Checklists



6. Alarm system and fire detectors
7. Transportation
8. Requirements for handicaps
9. Points of safety
10. Security zones (points of safety)
11. Signing
12. Employee training
13. Drills scheduling
14. System revision
15. Preventive strategies



IV. Progress Done

The progress done until this moment is the compilation of the necessary information for the development of the Emergency and Evacuation Systems. This information is related with the classification of the emergency situations, the Emergency and Evacuation Systems requirements, standards, and general models. The *Río Piedras Station* detailed drawings were obtained. These drawings are going to be use for the development of the Evacuation System. Also, general recommendations were developed based on the railroad accidents reports and emergency situations occurred in Puerto Rico.

Most of this information is presented in this report. This is going to be use as the model for the development of the systems.

General Evacuation Plan

1. TU users and employees shall evacuate the facilities using the designated exits.
2. TU users and employees shall be located in the designated exterior areas.
3. TU users and employees shall stay in the designated area not interfering with the emergency agencies labor until it is notify that they can leave the area.
4. Management personnel shall verify their employees to determine if there is someone left inside the building.

Fire Emergency Procedure

1. Inform the Fire Department.
2. Activate Security personnel to perform their duties in the designated areas.
3. Evacuate the area.
4. The area coordinator should report the area status to the general manager.
5. Depending on the situation, the general coordinator will call other emergency agencies and will evacuate the entire area.
6. Emergency routes, exits, and stairs are going to be use during the evacuation.

Earthquake Emergency Procedure

1. Stay calm.
2. Look for protection inside the building to hide yourself from falling objects.
3. Do not try to evacuate the facilities, because it is possible that you could stay confine using elevators or stairs.



4. Stay away from crystal objects.
5. Do not try to light a candle, cigarette, because it is possible that an escape from a flammable gas has occurred.
6. After the earthquake is over, evacuate the facilities using the evacuation plan and get away from trees and light posts. Search for open areas.
7. Lying down (face down) is the best alternative for this type of situation.
8. Do not go back inside the building.
9. Follow the emergency plan and emergency personnel instructions.

Agencies

Agencies	Phone numbers
Emergencies / Emergencias	911
State Police Control / Policía	343-2020
Río Piedras Station / Estación de Río Piedras	765-0841, 765-6439, 274-1611
Fire Department / Bomberos	754-2330, 282-0364, 763-2543
Medical Emergencies / Emergencias Médicas	343-2550, 754-2550, 343-2222
Centro de Ambulancia Aérea	754-3535
State Civil Defense / Defensa Civil	724-0124, 289-9060
Hospitals / Hospitales	
Hospital San Francisco (Río Piedras)	767-4370, 767-5100
Hospital Del Maestro (Hato Rey)	758-8383, 758-7585
Hospital Pavia (Santurce)	727-6060, 727-7923
Hospital Metropolitano (Guaynabo)	782-7144, 782-5300
Servicios Médicos Universitarios	759-6934, 759-6781
TU Offices	
Utilities Companies	
Electricity / Autoridad de Energía Eléctrica	
Gas	
Telephone	



Emergency Communication and Operation Control Center

A. Procedures

- Communicate with the participating agencies using the direct telephone lines.
- Other details will depend on the available equipment.
- If the Operation Control Center is out of service:

Train operations shall continue, although in a degraded state if necessary.

Underground facilities shall have several areas with system telephone service at Emergency Management Panel and local control panels in the Train Control rooms.

B. Communication systems

- Telephones
- Intercoms
- Portable radios
- Fire Alarm System
- TU subterranean facilities shall be able to:

Receive, log, and annunciate fire alarm, trouble alarm, and supervisory alarm.

Receive, record, and log emergency telephone messages.

Have direct multi-channel radio communication with each agency.

Use the system to advise and direct patron response to emergencies.

Emergency removal of traction power

Two-way voice communication between OCC and the control tower for coordination of emergency operations

Emergency Management Panels (EMP) - to consolidate communication facilities. It contains emergency telephones and annunciation from the fire alarm control panel.

Auxiliary Emergency Management – emergency telephone, PA system access, backup system in case the principal shuts down.

C. Internal and external communication

	Patrons in	Station Agents	Train Operators	Transit personnel	Emergency response Agencies	Local Police	Fire Department
OCC	X	X	X	X	X	X	X
Patrons in situations		X					
Transit personnel		X					
Vehicles passengers		X	X				



D. Telephones

- Provide communication with all stations, structures, offices, power stations and substations, control towers, ancillary rooms and spaces, and locations along the guide way.
- Should be widely and prominently displayed.
- Emergency telephones subsystems:

May be used by the public, employees, and safety personnel.

Function: manual fire alarm, medical requests, and others.

Shall annunciate at an attended console at the SCB and/or the OCC and indicate origin of the call.

Operation shall require only lifting handset or pressing a button. This could produce the activation of an audible alarm.

Recording

Dial outside with no special codes.

E. Radio subsystem

- It will consist of a minimum of two channels of radio communication for security force use.
- Two-way radio voice communication from non-transit police and fire emergency personnel shall operate.
- Communication for personnel, vehicles, equipment, and stations.

Emergency Equipment

The emergency equipment can consist of automatic fire alarms, smoke/temperature detectors, sprinklers, fire extinguishers, and first aid equipment.

A. Fire Alarm System

- Fire-Reporting phone system to report a fire manually.
- Shall sound in a way it can be heard throughout the building and it shall be easily to identify.
- Shall be electrically supervised and equipped with battery standby power.
- Capable to use smoke detectors and temperature detectors.
- Alarms shall be announced in the OCC.

B. Automatic Fire Detection

- Shall be installed in all rooms to activate the pre-action sprinkler or other extinguishing systems.

C. Fire Extinguisher

- Shall be installed throughout the facilities preferable in the evacuation route.
- Shall be multipurpose.



- Shall be accessible and visible.
- D. Standpipe Systems
- E. Automatic Sprinklers
- F. Special Erling Systems
 - Pre-action automatic sprinkler or other extinguishing systems in areas that contain critical communications, telephone, and train control equipment and systems.
- G. First Aid Equipment
 - Determine location
 - Employee training
 - Check it periodically
- H. Equipment Maintenance
 - The equipment should be check frequently (each month) to ensure that they are in good conditions.
 - Every check should be recorded (day and person).
 - Check the equipment is accessible.
 - The fire extinguisher shall be charge each time it is empty.

Emergency Signal

1. Emergency exits shall be identified by visible signals.
2. Access to exits shall be identified by visible signals in areas were emergency exits are not near. Arrows are an alternative to identify the emergency routes.
3. Emergency exits signals near doors and corridors can be highlighted.
4. Emergency exits signals shall contrast with the area, possess a distinctive color. They shall be unique and instantly recognizable to catch the public attention.
5. There shall be sufficient number of signals to cover all areas.
6. Inspect it periodically and record it each time.

Additional Information

1. Posters with emergency procedures
 - Location
 - Quantity
2. Evacuation maps
 - Location - inside the elevators and cars and in front of the elevators



- Design
 - Shall indicate the best means of getting out the facilities and other alternatives.
 - Shall indicate possible obstacles.
 - Shall include the safety zones in the facilities.
 - Shall indicate where is the Communication Center.
3. A list of the fire extinguishers and their locations
 4. An available list of the emergency organizations, agencies that will provide help with their telephone numbers
 5. A list of the emergency personnel

Employees Responsibilities

A. Security Committee

1. Should be aware of their responsibilities
2. Should be qualified to lead in the necessary actions which might be required
3. Will organize and manage the emergency plan
4. Will be directed by a General Coordinator and Alternate Coordinator
5. The General Coordinator will activate the evacuation plan whenever it is necessary and will ensure the trainings for the employees
6. Each area will be direct by a coordinator that will be in charge of the execution of the emergency plan, preventive strategies, evacuation plan, first aid procedures, and others in his/her area.
7. Will be divided in three groups: extinctive team, evacuation team, and first aid team.
8. Functions:
 - The development of practices/drills to evaluate the evacuation plan.
 - Plan and coordinate employee trainings.
 - Ensure that the station has the necessary emergency equipment.
 - Ensure that the *Police Department* and the *Fire Department* are notified about any emergency situation.
 - Will assist to every meeting, training, and conference.
 - Will be trained for fire prevention, evacuation, and extinction actions, and for first aid procedures.
 - Guide people to emergency exits, stairs, and routes during an evacuation.



Security Zones

1. Protective areas and routes
2. Take in consideration handicaps
3. Draw these areas in the evacuation maps

Abandonment and Rescue

Determine the point of no return – Sometimes it is necessary to leave the emergency plan execution.

Trainings

The trainings are necessary to educate the TU employees and users about the emergency and evacuation procedures. The employees training should be develop by the *Puerto Rico Fire Department*. Some of the topics that shall be presented are the following:

1. Emergency procedure plans
2. System fire control and alarm systems
3. Emergency access facilities
4. Emergency exits and routes
5. Emergency medical aid procedures and policies / First aid training
6. Emergency communication systems and procedures
7. Emergency equipment use and location
8. Identification of emergency personnel

Drills

1. Shall be develop, at least, twice a year
2. Evacuation of the entire station

Recovery

1. After the danger is over it is necessary to perform a preliminary and quick/short facilities check.
2. Perform a security personnel meeting to report all the suffered damage and develop a procedure to be implemented.
3. Initiate an immediate recovery.



Maintenance

- Checklists – to evaluate and rate some of the safety features or their lack.
- Emergency routes shall be free of object that can interfere with the evacuation.
- Maintain free access to the exits. In this way, passengers will not be impended or blocked.
- Emergency equipment shall be check periodically.
- Inspection:
 1. Inspection checklist – record the findings to indicate conditions of equipment and procedures.
 2. Findings during previous inspections shall be reviewed to determine whether any discrepancy have been found, and if so, whether they were corrected or not.
 3. Reports – specific name, equipment, and its location. Make recommendations for corrective action course.



Emergency Situations in Puerto Rico

Wrong	Goods
1. People conglomeration – cause access problems for agencies and official cars. 2. People not necessarily helping, interfering 3. Parking space limited 4. Limited access to Río Piedras center. 5. Emergency actions were improvised by the agencies. (@ Dupont Plaza situation) 6. No fire detectors nor emergency equipment inside the facilities 7. No emergency personnel training 8. Owner does not want to leave their buildings. 9. Employees tried to put out the fire before calling the Fire Department. 10. Necessity of a Quick Response Team. 11. Firefighters were not trained completely. 12. Obsolete pipes @ Río Piedras 13. Low water pumps quantity	1. Police officers and other emergency agencies helping with the traffic jam. 2. Organize plan and actions (Río Piedras explosion) 3. Firefighters – fast arrival and work (Río Piedras explosion) 4. Nation's solidarity expressions



V. General Recommendations

1. Any fire magnitude should be considered seriously.
2. If it is possible, alert the employees inside the cars before an accident (crash) occurs.
3. Consider that fire department cars are big and slow.
4. Locate facilities near the station where the users can be placed if an emergency situation occurs.
5. Communication equipment and between agencies, emergency lighting, training, and evacuation routes information are really important.
6. Use visual material for the employees' training.
7. Train windows should be easily to move.
8. Consider adding instructions for cars' emergency windows or considering removable windows and kicking panels.
9. Give information to the users about the cars' emergency doors location and how to use the emergency doors release handles.
10. Give inspection and maintenance test cycles to the cars' emergency doors and windows.
11. Use direct phone lines.
12. Use an efficient power system – batteries, electrical, and fuel system.
13. Have computer access to car drawings, seating configuration layout, emergency exits, doors, and windows.
14. Verify that the interior car material meets specific performance criteria for the flammability and smoke emission characteristics.
15. Drill with emergency agencies to verify communication system and make changes to the evacuation system whenever it is necessary.
16. Identify and locate the alarm systems.
17. Develop the shutdown and startup procedures.
18. Verify if the egress provision for the evacuation are adequate.
19. Ensure that all doors open in the proper direction to facilitate egress of personnel in emergencies.
20. Ensure that egress routes can be followed in the dark or in smoke.



VI. Conclusions

The designing of the Emergency and Evacuation Systems is going to be based on the requirements and standards compiled until this moment. Helpful tools for the development of the systems are the checklists. By using these checklists it is going to be possible to verify that every aspect is included in each system.

It is necessary that the TU Subterranean facilities possess a communication system and an alarm system. Also, the interaction between the emergency agencies, their access to the station area, and the emergency procedure are another aspects that are going to be part of this model.

Other concepts that are going to be consider for the systems' development are the limitations in Puerto Rico that were present in past emergency situations and the handicaps' needs.

The development of the Evacuation System is going to be based on the station's drawings and on additional information that is related with the way that this system works on another subterranean stations.



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