

Career Episode#1

DESIGN & INSTALLATIONS OF ADDRESSABLE FIRE ALARM SYSTEMS FOR AL-HAYAT NATIONAL HOSPITAL JAZAN

1. Introduction:

Date: March 2016 to April 2017

Project Duration: 1 Year 1 Month

Location: Jazan, Saudi Arabia

Organization: **Al – Hayat National Hospital Jazan**
Al-Inma Medical Services Company (www.alinmagroup.com)

My Position: **Project Engineer (Fire Alarm System Design & Installations)**

- 1.1** Al-Inma Medical Services is the well renowned healthcare service providing company in Kingdom of Saudi Arabia. The Company's head office operates in Capital City Riyadh, and is committed to provide state of the art health care facilities to its patients. The company also promotes the program to maintain and upgrade all of its facilities in Jazan, Riyadh, Khamis and Al Qaseem region respectively, where as Facility Management - Engineering and Safety has been the most established department dealing with Electrical, Electro – Mechanical and Weak Current Electronics Systems designed and executed by experienced specialized engineers and consultants.
- 1.2** Al Hayat National Hospital Jazan has been established to provide state of the art health care facilities to local Jazan residents and suburban community, as the region has been under development since then and limited healthcare facilities have been available. I joined Al Inma Medical Services Company in March 2014. Where I have been able to establish myself as a multirole engineer in the field of electrical & electronics engineering. I have designed and accomplish multiple projects in Electrical System, Electrical Controls and Low Current Electronics Systems such as Addressable Fire Alarm System Design & Installations, CCTV Surveillance System Design & Installations, Nurse Calling and Paging System etc.
- 1.3** This career episode is related to the Design Implementation and Installation of Addressable Fire Alarm System. The project is executed keeping n view of the various safety concerned for 200 Beds Multi-Storied Hospital Building under the guide lines of

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Civil Defense, NFPA and IEEE standards for Fire Alarm Systems. Keeping in view - one of the major Disaster in the history of Saudi Arabia which happened in Jazan General Hospital on 25th December 2015 and claimed the lives of 24 people, a deadly blaze broke out; in a matter of minutes the smoke spread out throughout the facility injuring at least 84 staff & patients. While the investigations have been carried out the main reason has been found due to defects in Fire Alarm System and poor smoke management system which cause the spread of smoke in the facility and caused suffocation among the people.

1.4 Immediately after the incident, special steps has been taken by the Ministry of Health & Civil Defense of Saudi Arabia in order to ensure the safety of staff and patients working in the Healthcare facilities. So in-order to meet the criteria of Civil Defense (and to acquire the safety license as per new guide lines) I have been assigned the project for the design and installation of fully automated fire alarm system.

1.5 Project Scope

The aim of the project was to design an efficient, reliable, cost effective and multifunctional (Full Automated) Addressable Fire Alarm System for Al Hayat National Hospital Jazan. Previously the old system was Conventional Type along with multiple loops with un-balanced number of Detectors (Smoke & Heat), the system was very hard to trouble shoot secondly no location is identified suppose if the smoke broke out in one patient room the alarm will be triggered all over the facility, but it will be very difficult to trace the location in a huge building which can cause a major internal disaster and compromises the safety of the building.

I proposed a totally robust system which has been implemented across the world class facilities and suggested to upgrade the Conventional system into Programmable Fire Alarm System. So that all the locations can be programmed in the main control panel upon triggering the location will be pin pointed exactly so one can reach and access the location in no time which will reduce any un-expected disaster while the smoke management system (Pressurize Stair Case) will work in parallel with the Fair Alarm System.

I designed the system with following functionality dealing with various entities involved in the design of the project:

1. Configuration & Installation of Programmable Addressable Control Panel (Wide LCD Display)
2. Installation of addressable Smoke, Heat Detectors and Manual Call Points in Various Loops

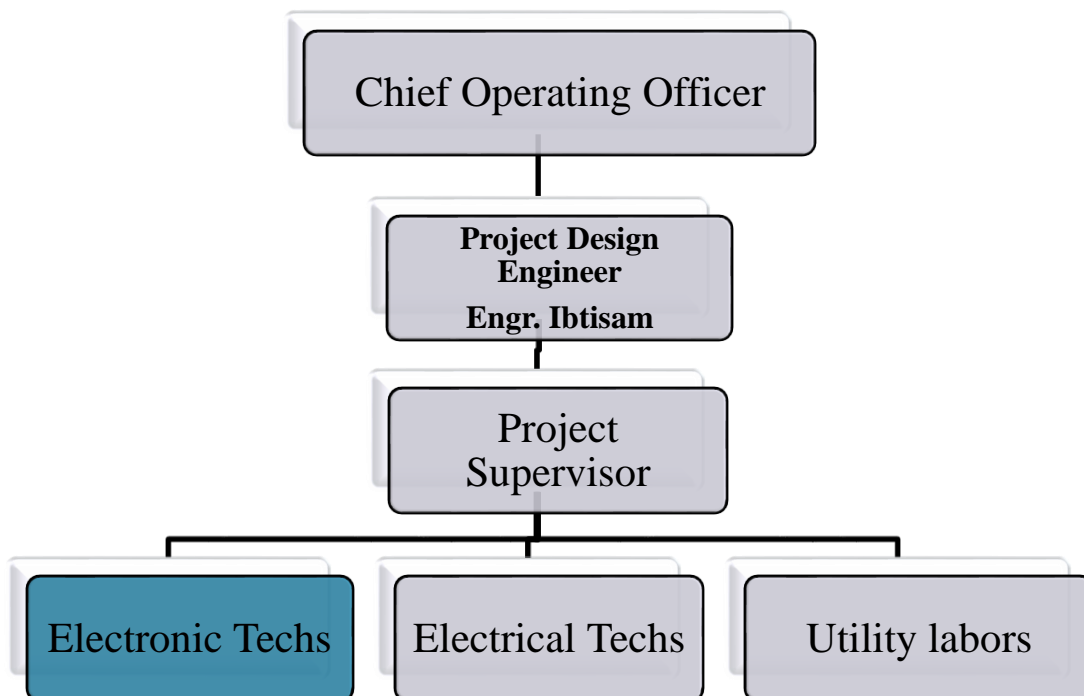
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3. Installation of Repeater Panels on 03 Floors of the Building with Narrow LCD Display
4. Magnetic Door Locks Automation with Installations (Buzzer Provided)
5. Automation of Elevators with Fire Alarm System
6. Automation of Fresh Air Handling Unit System Shut Down Control System
7. Automation of Pressurized Stair Case System
8. Installation of Electronic Flow Switches beside the zone valves of Fire Hydrant Main Line on each floor (In-case of No Pressure Mechanical Fault will be identified in the System)

The system will ensure complete operating safety and multiple options to facilitate the smooth operations of building.

1.6 Organizational Chart

The Project hierarchy is shown in the following diagram.



2. Personal Engineering Activity:

1.7 My Roles & Responsibilities

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- My task involved the complete study of various safety parameters, requirements, risk assessment, conditions and options available for the implementation of efficient, cost effective and reliable Addressable Fire Alarm System.
- I carried out general site visits on various critical locations of the facility with Chief Operating Officer to indentify the possible issues in case of any blaze.
- I acquired the complete plan of the building from Maintenance Manager for all the floors including the ancillary and utility buildings around the premises in-order to make estimation in regard with the total number of devices needed for the purpose including the cost estimation of the whole system along with 5 – Years cost of maintenance.
- After days of brain storming, research activities and studying various type of system available in the market and conducting site visits with my technical team I have been able to propose the installation of SIMPLEX Addressable Fire Alarm System (4100 ES - Made in USA) along with complete programming kit.
- The system is totally reliable with each detector / device has been provided with a specific 8 – bit address code changeable at the back of Detector Base. The system has multiple electronic control cards compatible with loop control cards installed as per the requirements. Signal Transmission and Receiving takes place in designated loops through all the devices. In- case if any device triggers (Smoke or Fire Detected) the Fire Alarm Control Panel will alarm in the defined zone and the designated location / area will appear on the display screen of Main Control Panel along with repeater Panels until Re-Set.
- I further contacted various vendors and suppliers for the availability of current system by acquiring quotations and comparing the type of systems with minimum cost and ease of trouble shooting solutions, submission of purchase order and completion of financial issues in order to receive the equipment in minimum time.
- I prepared block diagram of our system and submitted it to higher authorities for confirmation. I further prepared Single Line Diagram over AutoCAD along with specified floor plans for each floor of the facility. I have further used Building Information Modeling software such as Autodesk REVIT – MEP for designing the extended areas of Hospital Building.
- I performed loop cable estimations and cable routings while I proposed heat resistive and shielded cable to be used for the purpose with minimal resistance.
- I personally inspected and supervised the installation of Fire Alarm System along with my team members including Programming, Testing & commissioning of the complete system.

1.8 Problems faced & their Rectifications

- **Elevator Integration**

During an event of Fire it is highly recommended not to use the Elevators which can cause death due to suffocation due to any expected breakdown or smoke enters the

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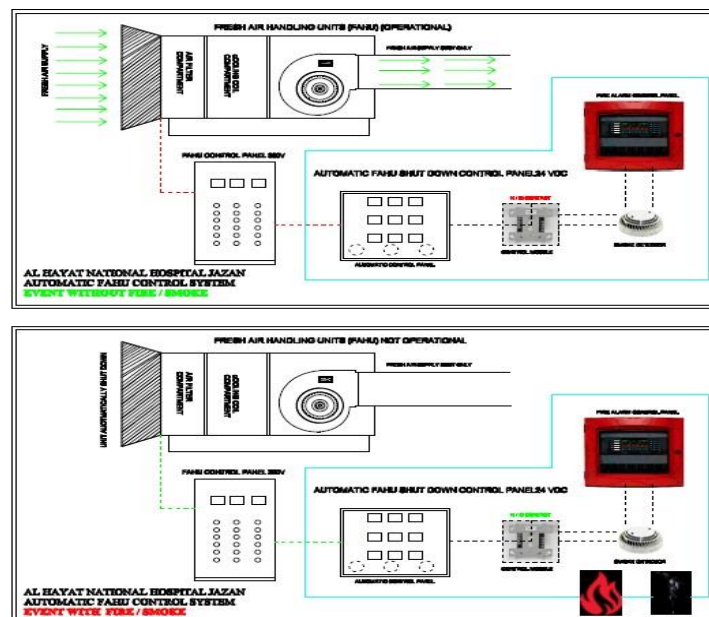
elevator shell. But how to avoid this situation in case is someone is using the elevator? If fire break out at the same time. Different control options are provided by manufactures so I ordered fire safety control cards to be installed and programmed in the Elevator by Mitsubishi (Manufacturer).

Final Solution:

I integrated the control card along with Fire Alarm System's addressable control module. When the Fire Alarm will trigger immediately the signal will reach the NO control Module which will return to NC immediately giving the signal to the elevator (As a result the elevator will cancel its operational movement immediately reach the ground floor the door will remain open and the power will shut down until the alarm will reset.

➤ Design of Automatic 24 VDC Control Panels for HVAC & Pressurize Stair Case System

Effect of problem: In an event of Fire the smoke travel via duct network and spreads various parts of the facility. I found out there were no smoke dampers & fire dampers



installed in the Duct Network which can cause a major disaster.

Root Cause of Problem:

This was indeed a major concern as no BMS System has been installed in the Facility for the automaton purpose and all the Air is directed in-side the facility as fresh oxygen supply which can be a fuel for any un expected fire and can let the smoke travel throughout the facility.

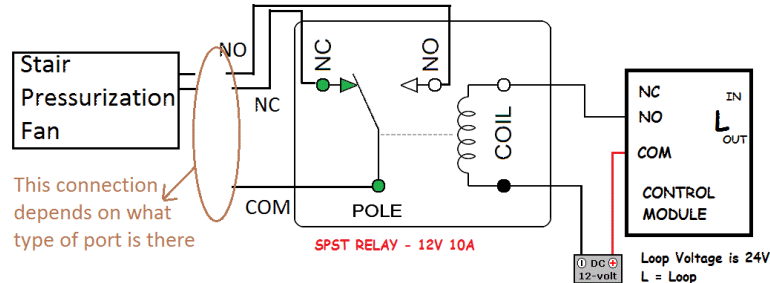
Final Solution:

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I designed a relay based automated 24 VDC FAHU Shut Down System which will control all the FHUS automatically and will be integrated with the main power distribution Panel of the FAHU's, in-case when the Fire will trigger it will immediately shut down the Fresh Air Supply to the Hospital saving the spread of smoke and cut of fresh air oxygen supply to the hospital. The same circuit has been implemented for various utilities such as: Stair Case Pressurized System Control, Magnetic Door Lock Control etc

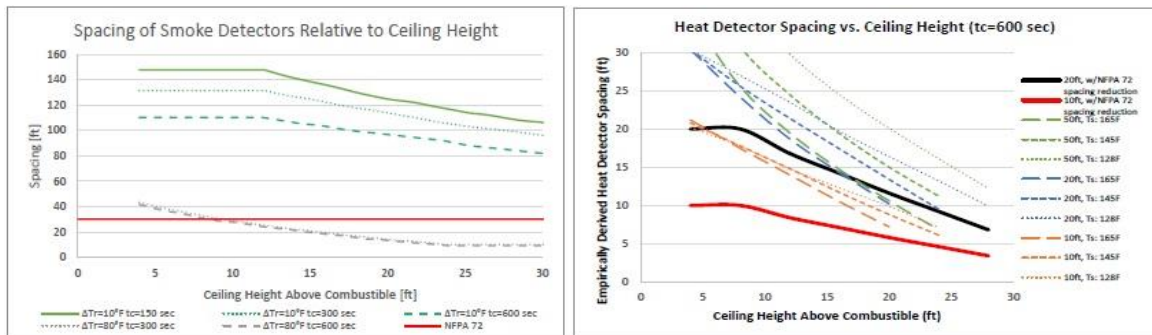
➤ Electronic Flow Switches

In order to enhance the complete safety system electronic flow switches has been added



beside each main valve of Main Fire Fighting Pipe line (This part was covered along with mechanical engineering division). In case if the pressure will fall which will trigger the flow switch and the mechanical fault will be identified in the main panel.

1.9 I computed required quantity of all the devices & sensors required by following NFPA guide Lines including the spacing between each device as per the guide lines mentioned.



I computed the Voltage Drop Calculations for Notification Appliance Circuit (NAC), which has helped me to further compute the resistance of the conductor. By using these parameters I have calculated total alarm notification device amperage. And then the total voltage drops in each branch circuit. A per NFPA Guide Lines if the branch Circuit Voltage Drops exceeds 4.4 VDC it will not be compatible with the standard as it can consume th battery life in – no time.

Following is the example for a Branch Circuit:

Wire Length (From Main Panel to End of Circuit = 200 Ft X 2 (Trans / Recev) = 400 Ft

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Used Wire Size = # 16 AWG (American Wire Gauge) [BELDED SHEILED MULTI CONDUCTOR CABLE]

$$\text{OHMS / Ft} = 1 / 1000 \text{ Ft} = 0.4 \text{ OHMS / FT}$$

$$\text{Circuit Resistance (R)} = 440 \text{ ft} \times 0.44 \text{ OHMS / FT} = 160 \text{ OHMS}$$

Total Alarm Appliance Amperage = No. of Appliance X Current Amperage Each = 23 mA

$$\text{Voltage Drop (E)} = 23 \text{ m (A)} \times 160 \text{ (OHM)} = 3.68 \text{ V} \quad (\text{Should Not Exceed } 4.4 \text{ V})$$

As per NFPA Fire Alarm Control Units (FACU) are tested to UL 864 and are required to operate at the End of Use Full Battery Life 20.4V

$$\text{Voltage Drop (V)} = 20.4 \text{ V} - (E) = 17 \text{ V} \quad [\text{Should Not be Less Than } 16 \text{ V}]$$

Keeping in view of above criteria all the devices in each loop has been balanced. Further More, I created the Detector / Sensor Profile sheet over MS Excel in-order to display the actual Location which will be programmed in the Main Control Panel for

HNH TECHNICAL FLOOR - LOOP1			
LOOP NO.	Location	Details	
GF-L1.SD 01	L1/1-GF CONTROL ROOM CORRIDOR	SMOKE DETECTOR	29
GF-L1.SD 02	L1/2-GF OPD SURGERY G028 ENT CLINIC	SMOKE DETECTOR	35
GF-L1.SD 03	L1/3-GF OPD SURGERY G029 CLINIC AUDOMETR	SMOKE DETECTOR	40
GF-L1.SD 04	L1/4-GF OPD SURGERY G0014-11ENT CONSULT	SMOKE DETECTOR	39
GF-L1.SD 05	L1/5-GF OPD SURGERY G0014-10G.S.ENDOSCES	SMOKE DETECTOR	40
GF-L1.SD 06	L1/6-GF OPD SURGERY G0014-04NEURO CLINIC	SMOKE DETECTOR	40
GF-L1.SD 07	L1/7-GF EXAMINATION ROOM CORRIDOR	SMOKE DETECTOR	33
GF-L1.MCP 08	L1/8-GF OPD SURGERY CORRIDOR.MCP	BREAK GLASS	32
GF-L1.SD 09	L1/9-GF OPD SURGERY G0014-12VACANT ROOM	SMOKE DETECTOR	39
GF-L1.SD 10	L1/10-GF OPD SURGERY G0014-13 G.S.CLINIC	SMOKE DETECTOR	40
GF-L1.SD 11	L1/11-GF OPD SURGERYG0014-14NEURO CLINIC	SMOKE DETECTOR	40
GF-L1.SD 12	L1/12-GF OPD SURGERY CORRIDOR	SMOKE DETECTOR	29
GF-L1.SD 13	L1/13-GF OPD SURGERY G0014-08UROLOGY.C	SMOKE DETECTOR	38
GF-L1.SD 14	L1/14-GF OPD.S.G0014-07 FEMALE WAITING	SMOKE DETECTOR	38
GF-L1.SD 15	L1/15-GF OPD SURGERY N.S.CORRIDOR	SMOKE DETECTOR	33
GF-L1.SD 16	L1/16-GF OPD SURGERY CLEAN UTILITY	SMOKE DETECTOR	34
GF-L1.SD 17	L1/17-GF OPD SURGERY DIRTY UTILITY	SMOKE DETECTOR	34
GF-L1.SD 18	L1/18-GF OPD SURGERY STORE ROOM	SMOKE DETECTOR	31
GF-L1.SD 19	L1/19-GF OPD SURGERY CORRIDOR	SMOKE DETECTOR	29

each device, as each component of the circuit has designated address and it cannot exceed 40 digits as maximum limit.

Design of Facility Layout:

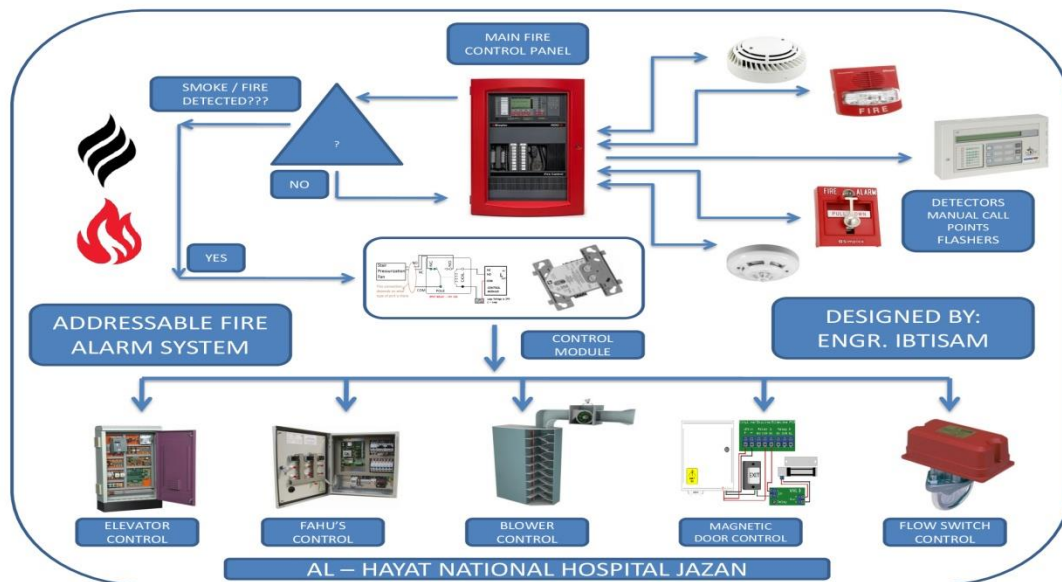
I designed the Fire Alarm System Floor Plan for each floor of the facility indicating the Specific Identification Number of each Detector and the actually placement along with the updated name for each location. I have used a separate color scheme / layer to separate each loop along with loop numbers.



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The design ensures complete safety, reliability and quality of operations based upon international standards.

- 1.10** I prepared the block diagram of the system and also implemented complete single line Diagram on AutoCAD software. I prepared the complete design & Schedule Booklet to be submitted to my COO to be submitted to the assessed by Governmental Authorities such as MOH and CIVIL DEFENSE Authorities.



- 1.11** I followed the safety manual for all the project work and these activities were carried out by trained workers resulting in no Safety issues or Environmental effects from this project. Adequate briefing sessions were given to the labor before starting any activity; discussing the safety aspects to be taken care while carrying the work, brief discussion on the standard procedure to carry out the work. Also indicated safety parameters, over current protection, Earth leakages Protection, and Earthing & Ground System and voltage drop computations.

- 1.12** Weekly I arranged meeting discussing status of the upcoming works, remaining clearances and resources allocation along with taking a gist of the previous completed works and made sure that papers were prepared and submitted to the concern authorities

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to get the completion certificate.

1.13 I used Electronic Work Bench Simulator, Revit – MEP, AutoCAD, MS Word, MS Power Point software in this project. I implemented various formulas over MS Excel I.e. (Quantity Computations, Cable Size Computations, Voltage Drop Computations) for my own convenience and ease of the project)

Summary:

1.14 The project was major success in my career and the efforts have been much appreciated by my sub-ordinates and team members after the successful implementation. I was able to achieve major design goals and challenges that occur during the design and installation of efficient and reliable Fire Alarm System. As a result our Hospital was able to get the License from Civil Defense ensuring that our facility is totally safe for the staff and patients.