SCADATRON

Airfield Ground Lighting Control System (AGLCS)

November 2002

Content

ABREVIATION

AGL	Airfield Ground Lighting
AGLCS	AGL Control System
ATC	Air Traffic Control
AVL	Automatic Vehicle Location
CCR	Constant Current Regulator
CPU	Center Processing Unit
DCA	Department of Civil Aviation Organization
FEP	Front End Processor
HMI	Human Machine Interface
ICAO	International Civil Aviation
I/O	Input/Output
LAN	Local Area Network
LCD	Liquid Crystal Display
LPU	Lightning Protection Unit
MMI	Man Machine Interface
M&E	Mechanical & Electrical
PLC	Programmable Logic Controller
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition
TAMS	Total Airport Management Sys.
TWR	Aerodrome Control Tower

The Company Behind The Concept

Since its inception in 1999, SCADATRON Products are designed and manufactured by Epeteknik Sdn. Bhd. Epeteknik as a system manufacturer and integrator is formed by a group of dedicated engineers with more then 10 years experience in this field. They made use of their recognised skill to seek out and select the very best material from the various vendors. The hard effort has led them to develop some very specialised equipment.

SCADATRON offers the most sophisticated equipment and techniques available : even more important, these facilities can be custom designed to suit the specific needs of each job. This extended options allows them to build up the best possible range of supplies integrating both the technical and budgetary constraints of any project.

Developing airfield ground lighting control systems calls for a very detailed knowledge of all the norms and experience for a highly reliable system. In this area, Epeteknik provide skill personnel who has involved in this field for Years.

SCADATRON Application In Airport Services

SCADATRON offers some specialised Equipment for Airport Services :

- Multiplexed Airfield Ground Lighting Control System
- Hardwired (Relay) Airfield Ground Lighting Control System
- Airport M&E SCADA /Control & Monitoring System
- Airport Ground Vehicle Tracking (AGVT) System
- Intelligent Remote Data Acquisition / Monitoring System
- Integrated AGLCS, Fire Supervisory, M&E SCADA System

Airport Ground Lighting

The airport lighting systems for most airports would consist of the following facilities :

- Approach lighting
- Runway Edge lighting
- Runway End lighting
- Runway Centreline lighting
- Threshold lighting
- Taxiway Edge lighting
- Taxiway Centreline lighting
- Taxiway stop bar lighting
- PAPI (Precision Approach Path Indicator)
- Movement Area Guidance Signs
- Obstruction lighting
- Parking Aids lighting
- Wind cone lighting
- Aerodrome beacon lighting
- Apron flood lighting

Normally an Airfield Ground Lighting control equipment is connected directly or indirectly to the Constant Current Regulator (CCR) for control of ON/OFF, lighting brilliancy and monitoring of feedback signals. The brilliancy can be two steps or three steps for taxiway edge lights, taxiway centreline lights and stopbar lights; Or it can be 5, 6 or 7 steps for runway approach, threshold, runway edge, centreline and PAPI. The number of brilliancy steps is configurable depending on the requirement.

Positive back / feedback indication on AGL control equipment can be as simple as Current regulator error/control error, Lamp failure or inclusive of Earth fault, Output Open circuit, Output Over-Current in a more complex system.

Airfield Ground Lighting Control System (AGLCS)

The Airfield Ground Lighting Control (AGL) control system provides the means of switching on or off or changing the intensity of the various lighting systems. Remote control and monitoring of all AGL systems is centred in the ATM facilities in the Aerodrome Tower. A multiplex AGLCS normally consists of 4 components :

- ATC Human Machine Interface (HMI)
- Master Control System
- Communication Network
- Local Control Systems

Air Traffic HMI located in Aerodrome Tower is basically computer SCADA terminals with touch screen displays. Through these terminals, air traffic controllers will be able to control AGL by means of touching the control buttons and monitor the condition of AGL indication through the runway mimic displayed on computer screens.

Master Control System comprises of Host computer and related equipment. This is basically a distribution / de-multiplexing equipment which connect between HMI and local control systems through its communication system.

Communication Network connects all the Local Control Systems in different substations to the master control system which is located near the Aerodrome Tower.

Local Control Systems are located in each AGL substation. The basic functions are control and monitoring of the lighting circuits through CCRs and switchboard in theAGL substation.

SCADATRON AGLCS Features

AGLCS Server HMI Server Features :

- Touch Screen as command input
- 21" CRT monitor or 15" panel mounted LCD as display media
- High resolution display (XGA normally)
- Back indication of accomplished commands
- Status indication of activated AGL
- Indication of Lighting intensities in %
- Frequent access control accessed by single strike action
- Less frequent access control accessed by two strike action
- Annunciation of control fault
- Annunciation of hardware/system fault
- Support Hot Backup Redundancy Server
- Fast change-over time on server failure
- Interlocking of runway services possible
- Using client/Server architecture
- Unlimited number of monitoring client
- Allow ready expansion
- UPS backup for uninterrupted operation
- Year 2000 compliant
- Standard SCADA software with open system architecture
- Fully equipped with AC lightning Protection (LPU)

AGLCS Monitoring HMI Features :

- Touch Screen or non-touch screen
- Real-time and historical information
- Authorisation code protection
- Back indication of accomplished commands
- Status indication of activated AGL
- Annunciation of control fault
- Annunciation of hardware/system fault
- Allow ready expansion
- Online printing using 80 or 136 columns printer
- UPS backup for uninterrupted operation
- Year 2000 compliant
- Standard SCADA software with open system architecture
- Fully equipped with AC lightning Protection (LPU)

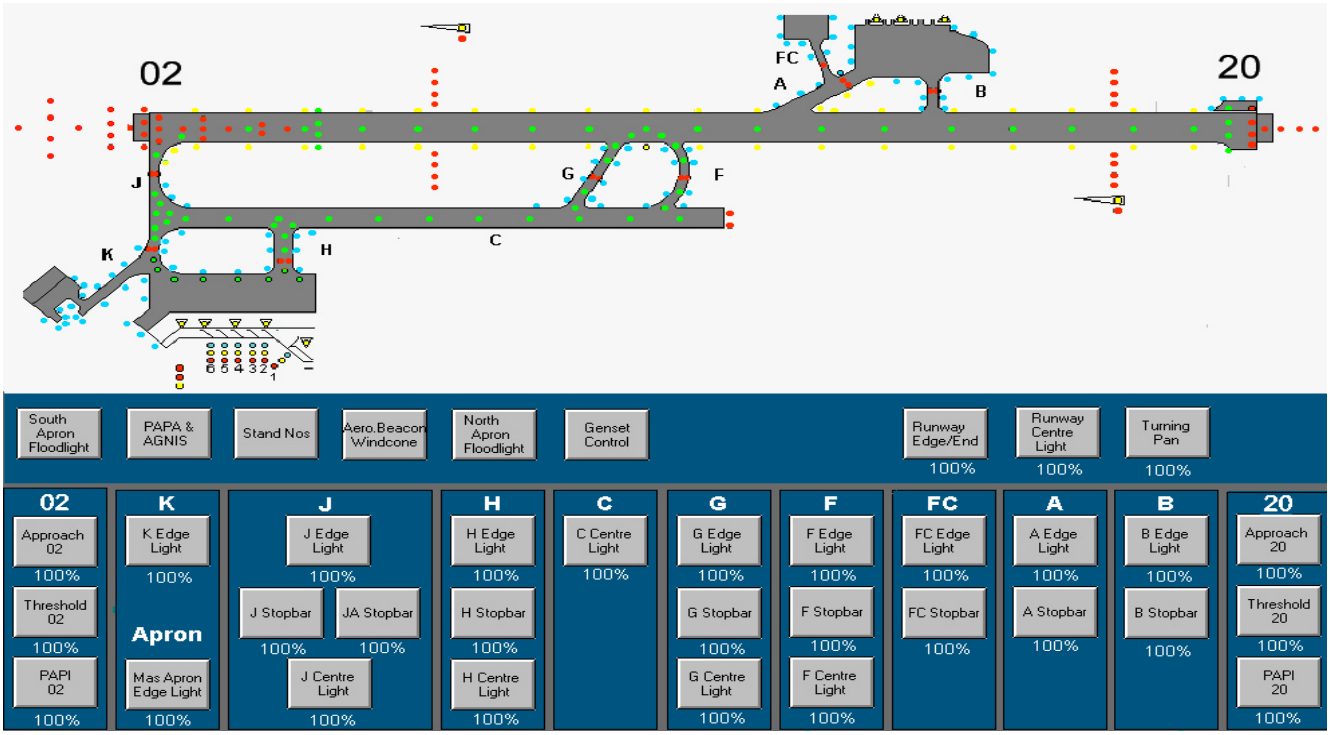
AGLCS Front End Processor Features :

- Support Hot backup redundancy FEP
- Support dual communication BUS
- Support Ethernet Local Area Network (LAN)
- Support Long Distance Modem (FSK) or Fibber Optic as communication media with RTUs
- Condensed information for short response time
- Industrial Standard Design
- For Long Hours Operation (24 hours a day, 365 days a year) with high MTBF
- Automatic detection of failed RTUs unit & automatic switch over to standby RTU when main RTU failed
- Automatic detection & switch over to the backup communication BUS line when the main BUS line is faulty
- Configurable number of retry on communication line before declare RTU failed.
- UPS backup for uninterrupted operation
- Embedded AC lightning Protection
- Year 2000 compliant

AGLCS Remote Station (RTU/PLC) Features :

- Support Hot backup redundancy RTU/PLC
- Support dual communication BUS
- Support Long Distance Modem (FSK) or Fibber Optic as communication with FEP
- Condensed information for short response time
- Industrial Standard Design
- For Long Hours Operation (24 hours a day, 365 days a year) with high MTBF

ATC Control Terminal With Human Machine Interface (HMI)



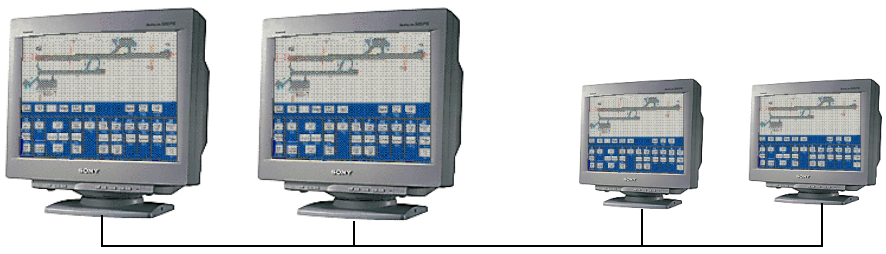
SCADATRON AGL control system (AGLCS) uses standard proven SCADA software as platform and configured as Human Machine Interface (HMI) which provide many state of art control/ communication features.

The HMI interfacing is designed in such a way that Air Traffic Controllers can operate the AGLCS with fast and minimum actions required. It is also designed for touch screen operations without the need of using keyboard or mouse. The AGLCS HMI screen normally consist of Runway MIMIC with control buttons on one screen and monitoring facilities indication on another screen. The HMI screen can be custom configured according to different airport needs.

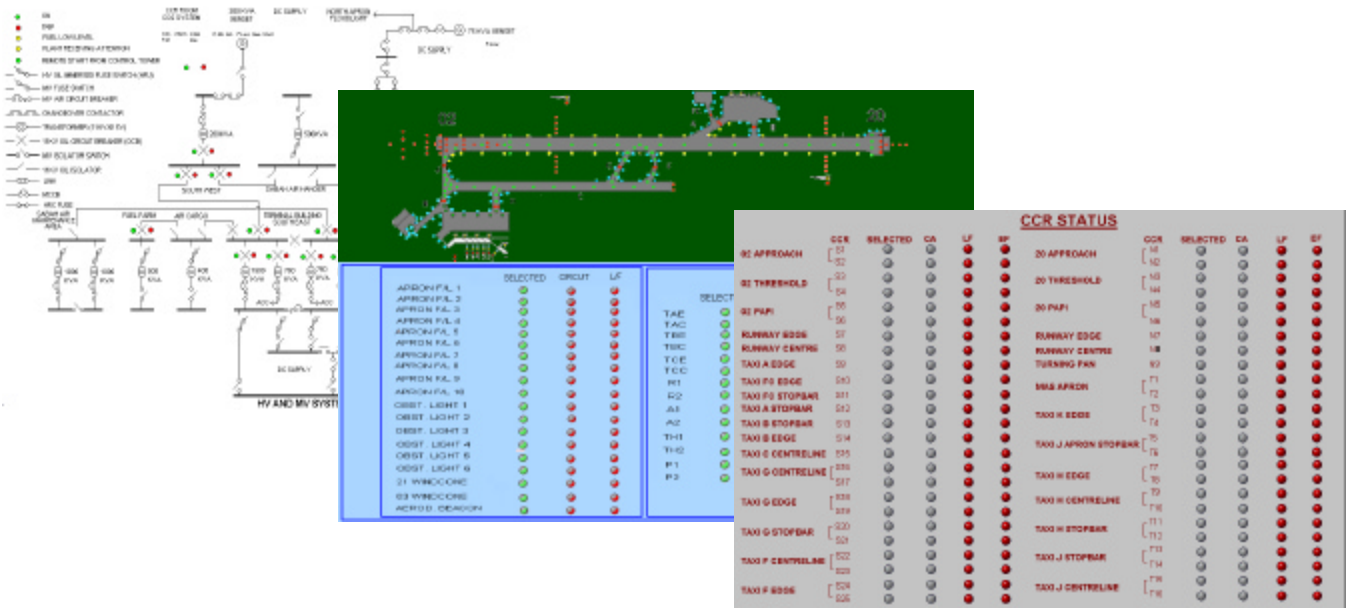
Human Machine Interface (HMI) Servers & Display Client

One (or two) of the HMI computer is configured as server(s). The servers communicate with the Front End Processor (FEP) or Programmable Logic Controller (PLC) and distributes information to other display nodes as required. The servers are normally located in the Aerodrome Tower.

On the other hand, other computers which does not play a role as server are called display clients which only allowed for monitoring / indication display purposes. These HMI computers are normally located in the monitoring room.



Monitoring HMI Terminal



A maintenance computer (monitoring Client HMI) normally located in the maintenance center receiving data from the tower server. This monitoring computer has the following functions :

- Runway MIMIC and Control (AGL control is not permitted without an authorization code)
- Print server (the logging printer is connected to it in monitoring room)
- Display the control state (On/Off, brilliancy steps) and AGL actual state (circuit activated)
- Display any control error alarm
- Display hardware alarm (FEP, RTU, communication BUS error)
- Display status / fault indication from CCRs (Circuit Activated, Earth Fault, Lamp Failure)

Data Logging And Printing

SCADATRON AGLCS is equipped with data logging facilities into the server HMI database. Any activity/activation of Input/Output signals is logged into the HMI hard-disk for record purposes. Alarm in terms of control failure (CCR feedback error or lamp failure) or system error (communication fault or RTUs fault) is also recorded as alarms in database.

Beside the soft copy in HMI hard-disk, any activation or feedback signals will be logged onto a printer connected to the HMI server or HMI display-client as hard copy. One of the example printout format is as follows :

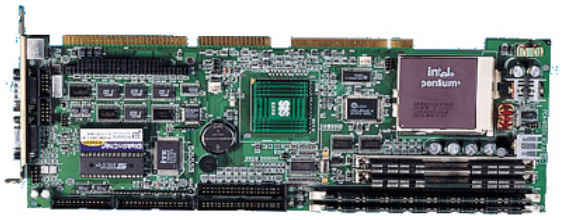
Date	Time	Services	Activity/Alarm
12/06/1999	12:00:45	PAPI 02	turned ON 100%
12/06/1999	12:00:50	PAPI 02	feedback ON
12/06/1999	12:01:30	PAPI 02	turned OFF
12/06/1999	12:02:15	Approach 02	turned ON 30%
12/06/1999	12:02:16	Threshold	turned ON 100%

SCADATRON SM2000 FRONT END PROCESSOR (FEP)

A Front End Processor (FEP) is basically a gateway for interfacing the HMI to different sub-systems in a large system especially when there are remote/distributed substations. In SCADATRON AGLCS, the FEP can be an industrial PC running a software on LINUX platform or host Programmable Logic Controller (PLC).

The FEP performs the following tasks :

- The main task of the FEP is to gather data from distributed local systems in sub-stations through the multiplex communication BUS (can be radio link, fiber optic or long distance MODEM link)
- Carry out efficient handling method of switching-over hot backup redundant RTUs and redundant communication BUS
- Transfer/Convert condense control/ monitoring data from local systems to HMI which is important for short responds time
- The data from local system is buffered data into its memory so that the HMI can obtain these data with a higher speed
- Other features of a FEP can be as a protocol converter to integrate with other systems (fire / building services, etc.)
- Provide closed loop control system (e.g. alarm annunciation, timer control operations) and other intelligent processing/ routing required in CAT II airport.



Single board Industrial graded Pentium 233MHz CPU card

In AGLCS which require its equipment to operate with high availability, the FEP is normally equipped with another standby FEP for hot backup redundancy. A FEP in such a system requires a minimum of 3 communication links ; one for communication with the HMI computer, one with its partner (standby/main FEP) and one link connects to main BUS/standby BUS for communication with its distributed local systems (PLCs/RTUs). In a small system, the FEP is not required, the HMI computer can directly interface to a PLC/RTU which control/ monitor its local Input/Output (I/O) points.

A FEP implemented using Industrial graded PC for reliable operation

SCADATRON SM2000 FEP Specification :

The CPU is mounted in a Heavy-duty steel rack-mount chassis with proper cooling fan and air filter. The CPU power supply is CE, UL, C-UL approved which can stand 25,000 hours MTBF (Min Time Between Failure).

1. CPU INTEL Pentium 233MHz
2. 512 KB pipe-line Burst Cache Memory
3. 32MB SIMM RAM, expandable to 72MB
4. Onboard PCI SVGA up to 4MB RAM
5. No Hard disk! 4MB solid–state ROM disk
6. One parallel port, Two USB Port
7. Two Serial port (One RS232C, One RS485)
8. 10MBps Ethernet network Interface (LAN)
9. Watchdog timer (CPU supervisory circuitry)
10. Panel mounted Keyboard
11. 19 " rack-mounting heavy-duty CPU casing
12. 250W CPU power supply, AC or DC operation
13. 15" CRT Monitor or Panel Mounted LCD

SCADATRON ST6000 FRONT END PROCESSOR (FEP)

A typical Front End Processor (FEP)

SCADATRON also offer Front End Processors (FEP) which are implemented on embedded microprocessor base embedded controller. The type of FEP is equipped with a 2 rows x20 column LCD display and a 4x4 keypad as user terminal.

The ST6000 Front End Processor (FEP) sometime referred to as Master Terminal Unit (MTU) provides a communication interface between Remote Sub-Stations with the Human Machine Interface (HMI). This Front End Processor (FEP) is capable of acting as a data concentrator to acquire data from difference type of Remote Stations with a combination of different communication media such as FSK Link, PSTN, GSM, PSTN MODEM, VHF/UHF Radio or Satellite Communication without adding any extra processing load on the Man Machine Interface (MMI). Even the remote stations can be built using similar ST6000 embedded CPU and the differences is only on the I/O configuration and software loaded to the CPU.

FEP in a 13U height 19" Equipment rack

The ST6000 embedded Front End Processor (FEP) is one of the industry most reliable controller which operate 365 days, 24 hours a day on critical SCADA operation without failure.

The ST6000 FEP is designed for easy support and maintenance due to it's components used is based on industrial most common microprocessor, the Motorola 68000 and other ICs general available in the market today off the shelve. ST6000 provide simple solutions to Hot Backup Redundancy (HBR) feature by using two CPU, one as main CPU and another as standby CPU with data exchange between 2 CPU through the RS485 serial port.

The software for ST6000 CPU written in ANS-C language running in a real-time multi-tasking kernel designed for parallel processing / computation. Modification on application program is made easy by simply modify the targeted routine / software module without effecting other software routine.

Programmable Logic Controller as I/O Distribution

In a distributed system such as AGL Control System which may consists of a number of AGL sub-stations, Programmable Logic Controllers (PLCs) or Remote Terminal Units (RTUs) play an important roles in transferring the input/output from the field (CCRs/switch boards) to the Front End Processor (FEP) which is located in the Master Control Station.

The connection between the PLCs/RTUs and FEP must be done through a reliable communication media over a long distance (3-6KM). A redundant Input/Output system need 2 sets of I/O modules with 2 CPUs (PLCs) and special software for I/O interlocking. On the other hand, a redundant communication bus system only required 2 communication ports/modules on the same PLC/RTU.

RTU CPU & I/ O Type : (GE-Fanuc 90-30 Series PLC)

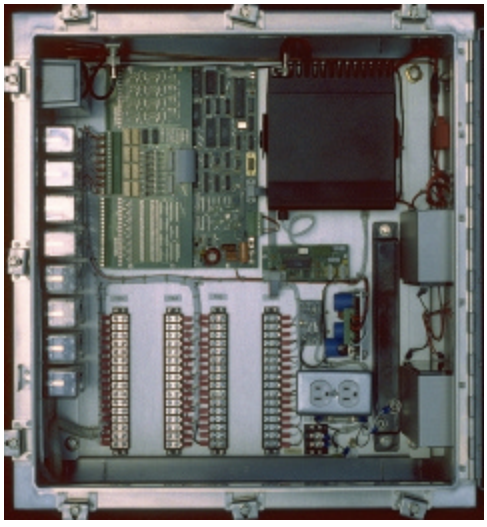
IC693CPU350: 9999 registers, SNP serial port, 16 bit high speed CPU, relay ladder logic

IC693MDL753: 32 channels Digital Output module
IC693MDL940: 16 points 2A relay output module
IC693MDL655: 32 channels Digital Input module
IC693ALG221: 4 channels 4-20mA Analog Input
IC693CMM321: Ethernet TCP/IP LAN module
IC693BEM331: Genius Bus (Factoiry LAN) module
IC693PCM311: Programmable Coprocessor Module

A GE-Fanuc PLC with power supply module, CPU module and some Input/output modules on a back-plane

Remote Terminal Unit as I/O Distribution

A RTU is best in used when there is no need for local processing. A RTU can be specially designed to suit the AGL application with low cost. A RTU can be small (CPU, communication and I/O embedded on a single card) for a substation with a small amount of Input/output point count.



A Typical Remote Terminal Unit Layout with I/O Cards

A large local system where I/O point count is large, a RTU design similar to the FEP using Industrial Graded Computer can be employed. High speed parallel bus line card is installed on each Industrial PC and connected to the shared I/O module using a switcher card.

RTU I/O Card Type :

STDO32: 32 points Digital Output with 2A relay contact
STDI32: 32 points Digital Input with relay isolation
STDI32O: 32 points Digital Input with opto isolation
STSWR: I/O sharing Switcher Card for 2 CPU,2 I/O BUS
ST20: 1 channel FSK MODEM Module
ST30: 2 channel FSK MODEM Module
STAI8: 8 channel precision Analog input module

Hot Backup Redundancy

One of the basic configuration requirement for a reliable AGL Control System is hot backup redundancy for uninterrupted control operation. There are a number of ways to implement redundancy on SCADATRON AGLCS :

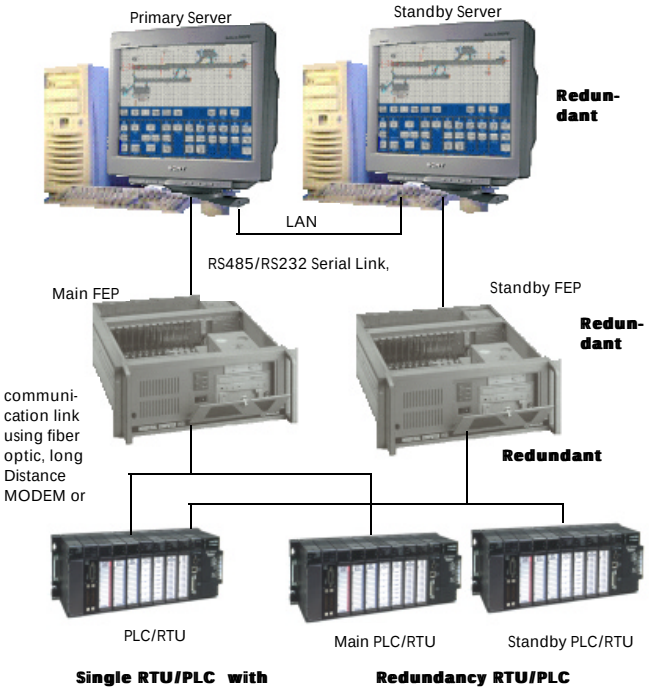
- HMI redundancy
- Communication network redundancy
- Front End Processor redundancy
- PLCs/RTUs redundancy
- Input/Output Module redundancy

To achieve ***HMI Redundancy***, two numbers of HMI computers are configured as primary and standby servers. When the system is in operation, both server are identical to the users which means that there is no difference in operating on either one of the touch screen. In actual fact, the primary server is normally performing communication with the FEP, when the primary server failed, the standby server will assume total control (through the LAN) without any interruption to the control system.

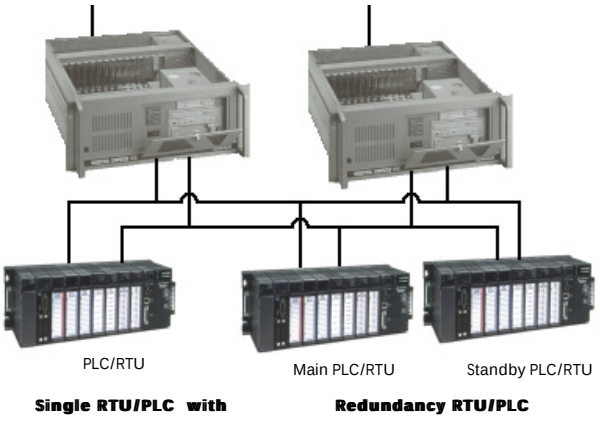
A ***Redundant FEP*** is needed in a distributed AGLCS where failure of any of the FEPs will not interrupt the data flow from the local PLCs/RTUs to HMI computer.

Communication Redundancy is most important for AGLCS since the communication link between the FEPs and PLCs/RTUs is exposed/outside the building which may caught in lighting surge. If one of the BUS line is down or any of the communication port of RTUs/PLCs is faulty, the other BUS line should be in-used and maintain the link.

In a conventional hot backup redundancy system, when any of a main RTU or FEP is down, the complete System A (main FEP/RTUs) need to shut down and System B (standby FEP/RTUs) take over. It is illustrated in the configuration diagram on top right corner. The bottom right corner show a more flexible communication system. In this configuration, main or standby FEP can communicate with both main and standby RTUs which means that a complete switch-over to BUS B is not necessary when any of the main RTUs is down.

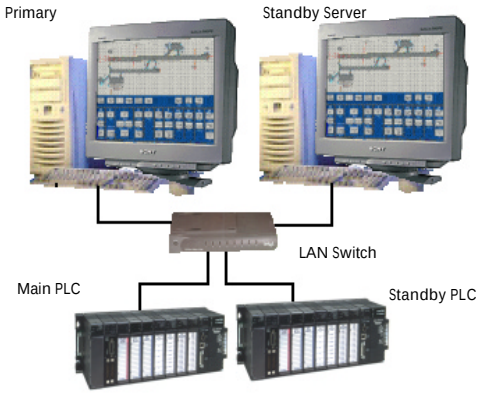


System Configuration Diagram for a AGLCS with HMIs, FEPs and



Fully Redundant Communication BUS system using two communication module on each RTU

System Configuration 1



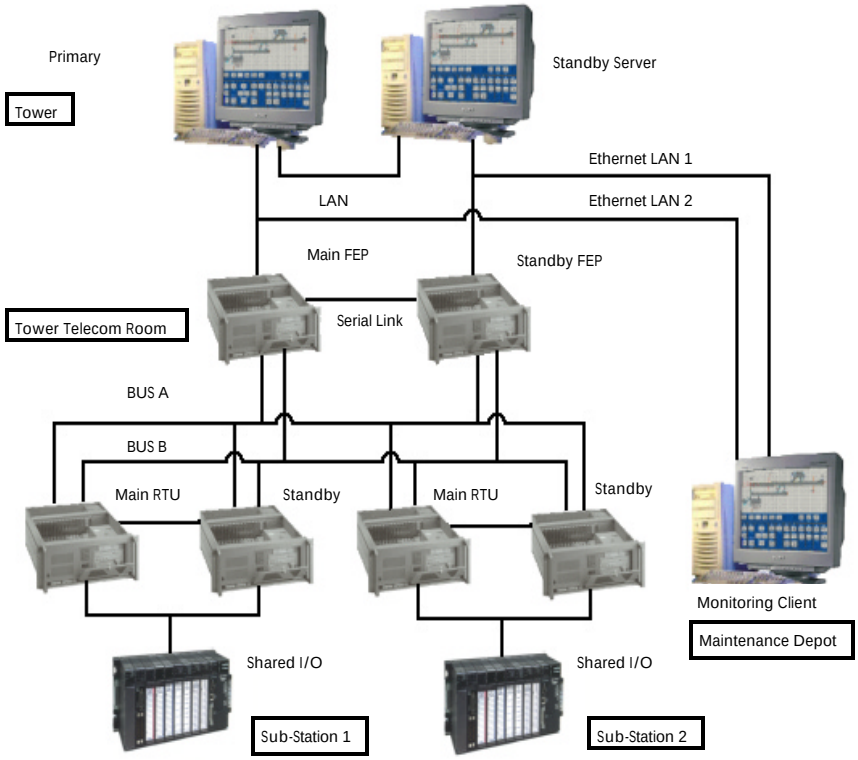
In a simple AGLCS, The two HMI Server is connected in LAN with two PLCs/RTUs to implement hot backup redundancy. The Input/Output of the PLCs/RTUs is parallel together for a redundant RTU's CPU and Input/Output configuration.

In normal situation, the Primary HMI Server and the main PLC/RTU is active/in charge. When the main HMI server failed, the standby HMI server will take over to communicate/control the active PLC/RTU. In other hand, if the active PLC/RTU failed, the other inactive PLC/RTU will become active and take over the control function of the system.

System Configuration 2

A system with shared I/O module will remain the benefit of hot backup redundancy feature on the substation's AGLCS equipment but with an extra cost saving on the I/O module. Instead of needing two sets of I/O modules, one set of I/O module is shared by two of the sub-station RTUs. Normally only RTUs is configured to have this type of facilities because the cost of setting up PLCs in the similar configuration is costly.

The FEP is connected to the HMI server on the ATC using redundant communication link; which can be Ethernet LAN (10BaseT using UTP cable or 10Base2 using coaxial cable) or isolated RS485 serial link.

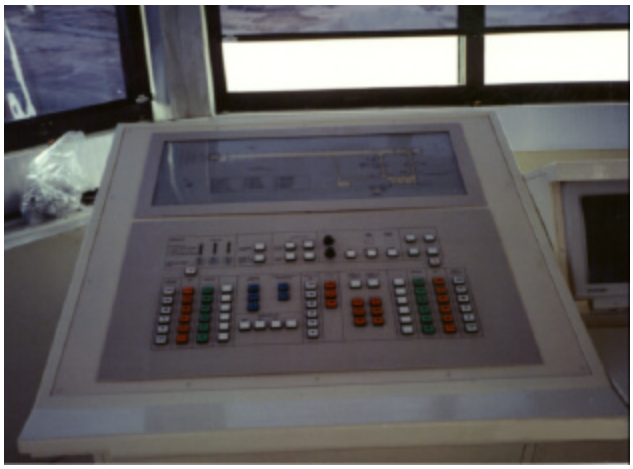


The monitoring HMI in the maintenance center is mainly used by the maintenance staff to monitor the status/alarm of the AGLCS equipment. If by any chance that both of the servers are down due to communication link from tower to the FEP located in the tower technical room or monitoring room, the monitoring HMI is designed to be the last resource where the system still can be control through the monitoring HMI by the maintenance staff. Note that in normal operation, AGL control is not allowed in the monitoring HMI with password protection.

Hardwired Relay Controlled AGL Control System

An alternative system offered by SCADATRON is hardwired / conventional relay controlled AGLCS. In a hardwired system, there is no intelligent/microprocessor-based system involved.

A hardwired AGLCS consists of a number of modular relay cards on which loaded with relays, passive devices (resistor, capacitors) and solid state devices (transistors and diodes) and minimum use of Integrated circuits (ICs). The control console in the Aerodrome Tower consists of a control desk with all the control buttons with on/off and brilliancy control selections. The runway MIMIC on the control desk can be constructed from LED indicators (red, orange, green, yellow) on clear perspex or mosaic modules.



A control desk with control buttons and runway mimic

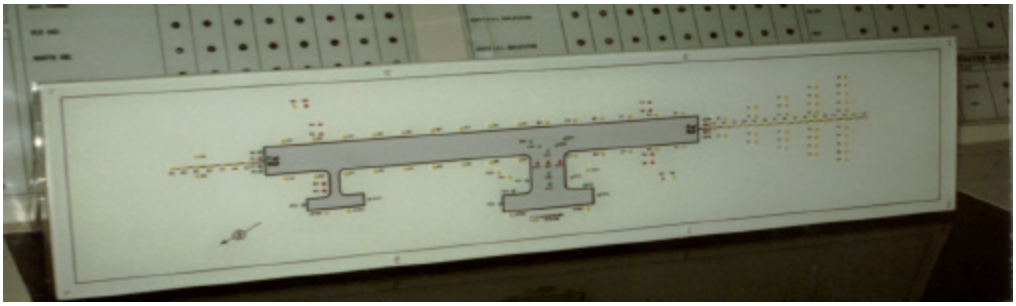
The advantages of such a system are its fast respond time, simplified maintenance, high reliability and low cost. The disadvantages are not-user friendly for additional new services (especially to the control desk) and the cost of laying control cable for non-multiplex system is high. The following is some of the modular relay card available :

- Dimmer control / flasher card
- Control and monitoring relay card
- Interlocking service relay card
- CCR Brilliancy control relay card
- Alarm processing relay card

Features :

Some of the hardwired AGL Control System features are as follows :

- Separate runway MIMIC Indicators & Control Buttons dimmer control
- Control Button/MIMIC indicators flashing after certain timeout period (Control Failed)
- Interlocking between two runway direction operations
- Modular design to ease maintenance (modular relay cards)
- Utilized 24V or 48V as operating voltage with long-hour battery backup
- Reliable Operation with Fail save design
- Guaranteed fast response time
- On/Off & 6 steps brilliancy selection/changes by using single push-button operation



A example of runway mimic display constructed using LED indicators

Epeteknik Sdn.

Office Address :
Epeteknik Sdn. Bhd.
41, Jalan TPJ8, Taman Perindustrian Jaya,
47200 Petaling Jaya,
Selangor Darul Ehsan,

Phone: +603-78468829
Fax: +603-78468892
Email: epeteknik@po.jaring.my
URL: www.epeteknik.com.my/epeteknik

EPETEKNIK
SCADATRON PRODUCT

AirFIELD Ground Lighting Control Systems

We're on the Web!
www.epeteknik.com.my/
epeteknik

How To Choose An AGLCS Configuration?

Configuration of An AGLCS depends on the following criteria : size of the AGL services, numbers of sub-stations available, distance of sub-stations from ATC tower, airport in operation or new airport, any existing wiring between ATC tower, monitoring room and sub-station, distance of monitoring room from ATC tower, the requirement of a hot backup redundancy system, size of AGL services is fixed or expansion needed in near future, the requirement of supervisory console/display node in maintenance center, the requirement of M&E monitoring in the same system and the allocated budget.

All the criteria above will determine the following option : hard-wired (non-multiplex) or multiplex AGLCS, the requirement of a FEP, control desk or touch screen HMI in ATC Tower, direct control cable from ATC tower to sub-station or through multiplexed communication cable, fiber-optic link/FSK long distance MODEM/UHF radio MODEM as communication link to substations, redundant or single HMI, redundant or single FEP, redundant or single RTU, redundant I/O or shared I/O, PLC or RTU in substations, HMI Client or supervisory console in maintenance center, fiber optic link or Ethernet LAN from ATC Tower to Monitoring room.

Why use SCADATRON AGL Control System?

SCADATRON is designed and manufactured locally in Malaysia. The quality is assured because it is designed to satisfy local and overseas market. SCADATRON AGLCS products are designed by system experts after years of experience in AGLCS systems and SCADA application with the know how in software & hardware design.

Epeteknik is committed to give full support on the Scadatron software or hardware packages to the customer satisfaction. The experts in Epeteknik have the capability to recommend the best system configuration to suit the client requirement based on their experience in this field. Besides, they also have the capability to customise-design the AGLCS to cater for any possible upgrading work which utilise existing equipment and so reducing the cost involved.

Every Scadatron system comes with complete operations & maintenance manuals and a summarised operation instruction page. The philosophy of the company is not to supply a system which can only be maintained by the manufacturer but to supply a system which can be maintained by the users themselves.

Authorized Dealer :