CLEARSY

Safety Solutions Designer

September 2025

AIX
LYON
PARIS
STRASBOURG

WWW.CLEARSY.COM

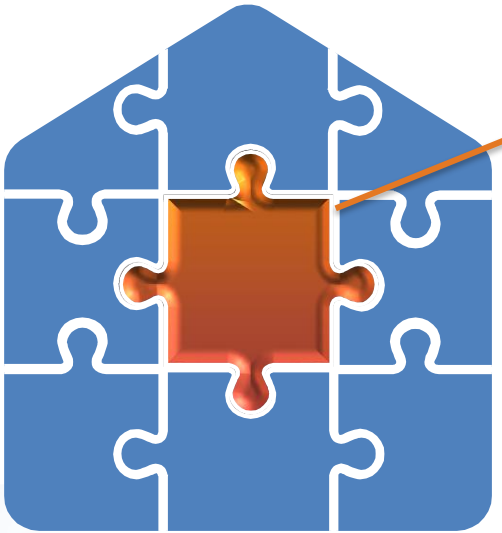
System analysis and renovation services

CLEARSY's expertise in complex customised projects

CONTACT@CLEARSY.COM

Problematic

Complex system = multiple sub-systems



Critical system to be replaced/renovated/modernised

- Obsolete equipment
- Need for upgrade
- Interface change
- No standard equipment available
- Need for assistance

The challenges

Compliance

Validation
In-service support
Obsolescence

Evolution

Retrofit
Modernisation
New features

System control

System study
Safety

Independence

New interface
Independent review

CLEARSY approach

- Implementation of a methodology
  - Documentation analysis
  - Information from users/operators/maintenance
  - Step-by-step progress (feasibility study)
  - Reconstruction of functional and technical specifications
  - Iso-functionality testing on old and new equipment
- … supported by toolkits
  - Digital and analog communications record equipment
  - Environment simulation (signal generator)
  - Adaptation to all types of connectors (CLEARSY electronics lab)
- … and versatile HW/SW specialists
  - Field experiences
  - Knowledge about or able to understand older technologies
  - Attentive to operational and maintenance issues

CLEARSY solution

Complete offer covering all or part of the product life cycle

Study / Analysis

Definition of needs, risks, key objectives
Operating /safety principles
Analysis of discrepancies / standards

Custom development

Obsolescence management
“Plug’n play” solution
Features/safety loop
Re-engineering/reverse engineering

Verification and validation

Automatic test bench
Factory and on-site testing/ qualification and certification

Support

Improved reliability/safety
Training, maintenance, support

Safety-critical software

Complex software

- Compliance with standards EN5012X, EN 61508, etc.
- Complex algorithms

(localisation, braking curve calculation, etc.)

- From SIL2 to SIL4
- Development of safety applications on standard hardware

Formal Methods

- B Method expert
- CBTC/ATP application development
- Formal data validation
- Safety property validation

atelier B

Existing SIL4 calculator

- Existing platform
  - Interface motherboard offering
    - 32 non-safety inputs
    - 32 non-safety outputs
  - Rapid prototyping capability
  - Calculator up to SIL4 level

- CLEARSY safety controller
  - Based on the SIL4-certified CLEARSY Safety Platform
    - Programmable in B (formal language)
    - Integrated into a 3U rack with 4E/3S
    - 1 ETHERNET base 10/100 TX
    - Compliant with railway standards
    - Generic power supply (24VDC or 110VDC)

  - 100% French product, adaptable, mastered and developed by CLEARSY

Automation and communication protocols

Industrial automation (PLC)

- ✓ Proficiency in safety/industrial controllers
- ✓ Safety-compliant development process
- ✓ Possible use of formal methods
- ✓ PLC reverse engineering
- ✓ Migration to new generation
- ✓ Automated testing & test bench

Communication protocol

- ✓ EN50159 security protocol (adapted or customized)
- ✓ Implementation of interfaces: Ethernet/IP, Modbus, Profibus, CAN, air-ground links, wireless, etc.
- ✓ Customized gateway design

Platform screen doors - Kuala Lumpur - Malaysia

- Context
  - Obsolete system
  - Limited design data
  - Requirement to maintain operational condition and compatibility with existing system (3F)
  - SIL2 system
- Methodology
  - On-site analysis of interfaces, installation of on-site recorders to specify operation
  - Modelling and design of a new circuit board, new hardware and new software
  - Setup of a laboratory test bench + on-site testing
  - Manufacturing and serial production
- Results
  - System compatible with existing equipment (interface, form and function)
  - Serial production (+100 units)
  - Training and support for maintenance personnel

System study – Metro operator – traction logic

- Context
  - System over 40 years old – limited documentation – standards evolution
  - Diagrams available but no safety analysis
  - Need for upgrades
- Methodology
  - Workshops organized with customers and experts
  - Analysis of schematics and description of security demonstration
- Results
  - Identification of required properties for safety
  - Definition of required constraints for developments
  - Reports for capitalization

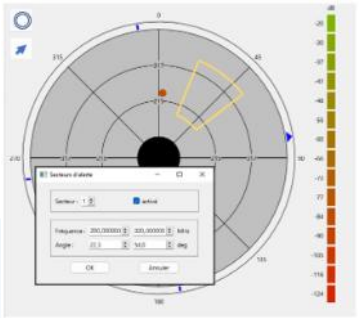
Custom interface gateway design – drone

- Context
  - Replacement of a communication system on a drone
  - Integration issue (protocol compatibility)
  - Existing system difficult to modify
- Methodology
  - Interface study
  - Modelling of the solution for laboratory testing
  - Product validation and industrialization
- Results
  - Development of a custom gateway module ensuring compatibility with existing and added protocols
  - Implementation of serial production (80+ units)
  - No change to the existing architecture

References on formal proof

- New York and Paris metros (MTA et RATP)
  - Full proof of the safety of their multi-supplier specifications (possibility of purchasing trackside equipment or onboard from different suppliers and interchanging them)
  - All aspects are covered: the various subsystems, maintenance, rolling stock, equipment, operation, etc.
- HPMV (SCNF) – ligne from Marseil to Vintimille
  - Full safety justification of the specifications – formal proof
  - Only one-week service interruption
  - Removal of all signaling lights (no backup)
  - Must operate safely regardless of who operates the trains (European market liberalization)
- Results
  - Formal evidence file (in French or English)
  - Focus on problematic cases
  - Proven mathematical model
  - Possible simulator and scenarios to replay dangerous cases

Renovation of critical control systems



- Context
  - Obsolete and poorly documented system
  - Critical for operations
- Methodology
  - Preliminary feasibility study (risk identification)
  - Reconstruction of functional specifications
  - Field testing with users / data collection using specific tools developed ad hoc
  - Factory validation with proof of iso-functionality
- Results
  - Systems renovated in less than 18 months
  - In operation
  - New manufacturing package and reproducible system

Advantages of the CLEARSY's solution

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Expertise in critical safety systems

Calculator/usable technological blocks
Many references in operation
Strong knowledge of safety standards

Flexible and tailor-made approach

Rapid prototyping, feasibility study
Turn-key to customer requirements
Analysis of existing environment

Results-based commitment

ISA certificate provided
Manufacturing carried out by CLEARSY or customer
Design to cost

CONTACT

www.clearsy.com

contact@clearsy.com

320 Av. Archimède – Les Pléïades III
13100 Aix-en-Provence
FRANCE