



# Energiforsk

Lifetime Extension of Nuclear I&C  
I & C Obsolescence and PLEX  
October 27, 2016

Curtiss-Wright Nuclear Division



It all started on  
the sands of Kitty Hawk over  
100 years ago



Glenn Curtiss



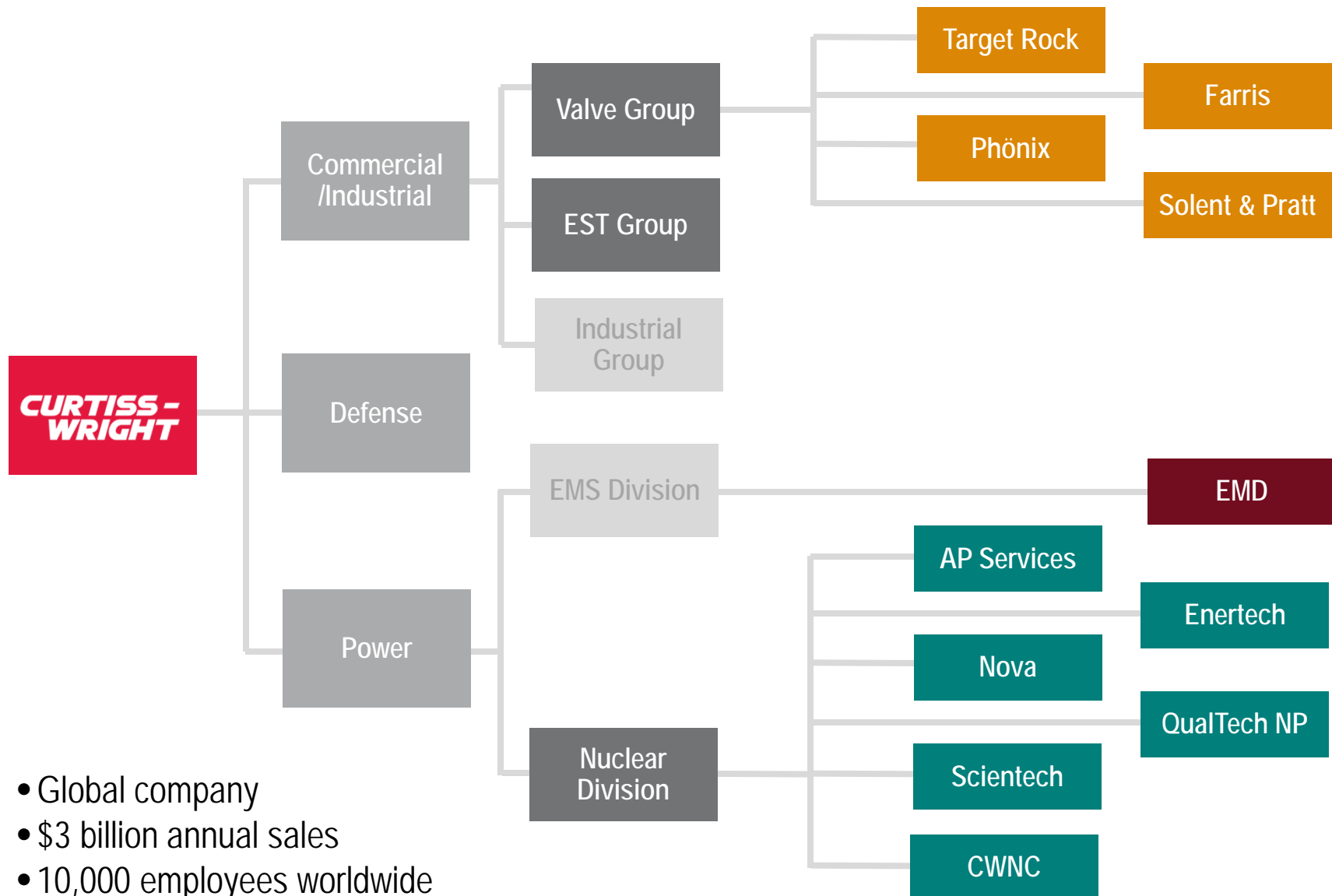
Wilbur Wright



Orville Wright

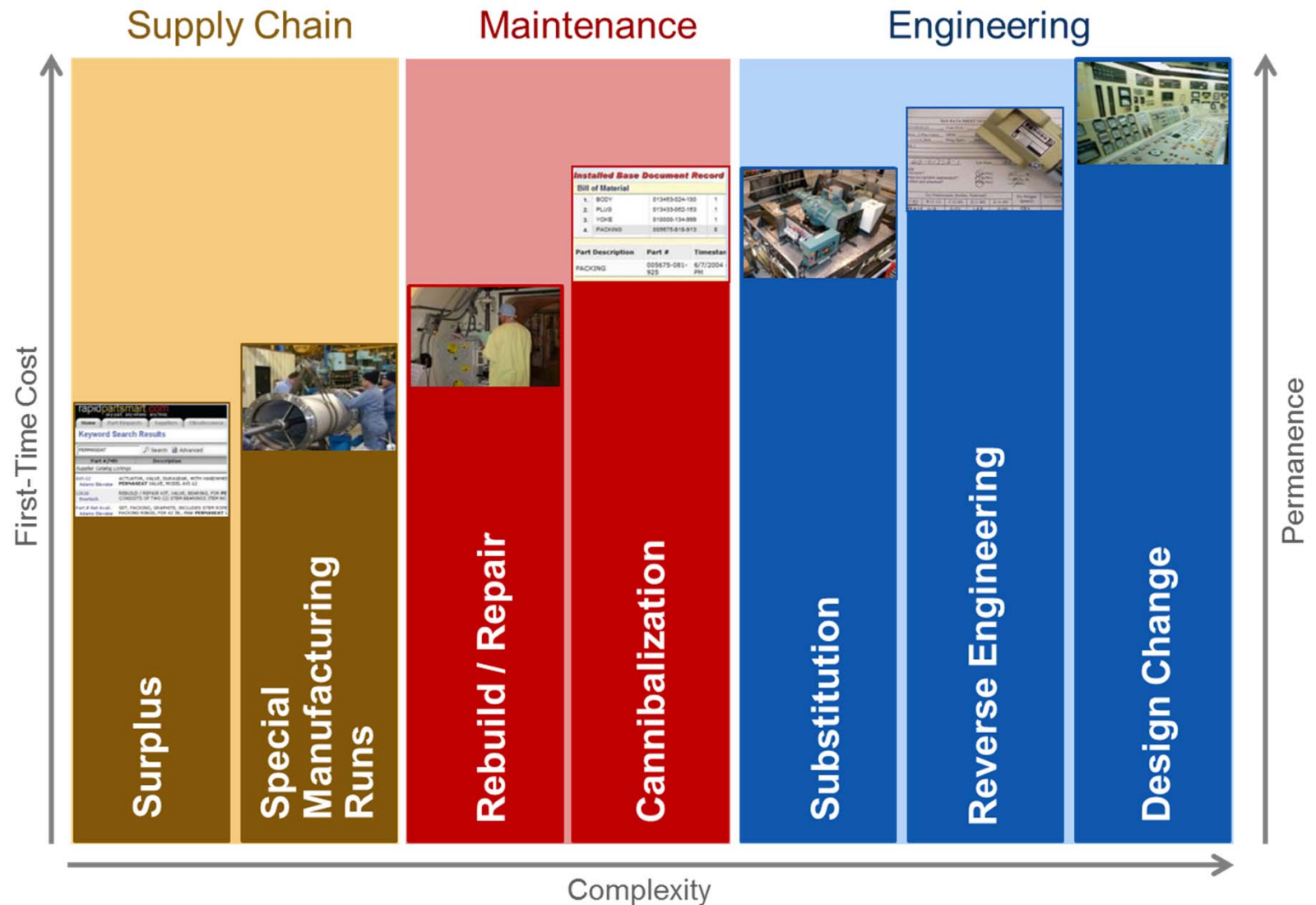


# The Curtiss-Wright Nuclear Organization



- Global company
- \$3 billion annual sales
- 10,000 employees worldwide

# Seven Ways to Address Equipment Life for PLEX



# Surplus

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- The easiest approach is to find the same equipment somewhere.
- Many systems and components used in nuclear plants were also used in fossil power plants, chemical plants, waste water plants, and oil and gas processing applications.
- New or used surplus equipment can be refurbished and certified for use in non-safety or safety applications.
- This provides an exact replacement with no changes to the plant's paperwork or procedures.
- *C-W QA programs includes procedures for re-furbishing and re-certifying non-safety or safety related surplus equipment, based on the original qualified status..*





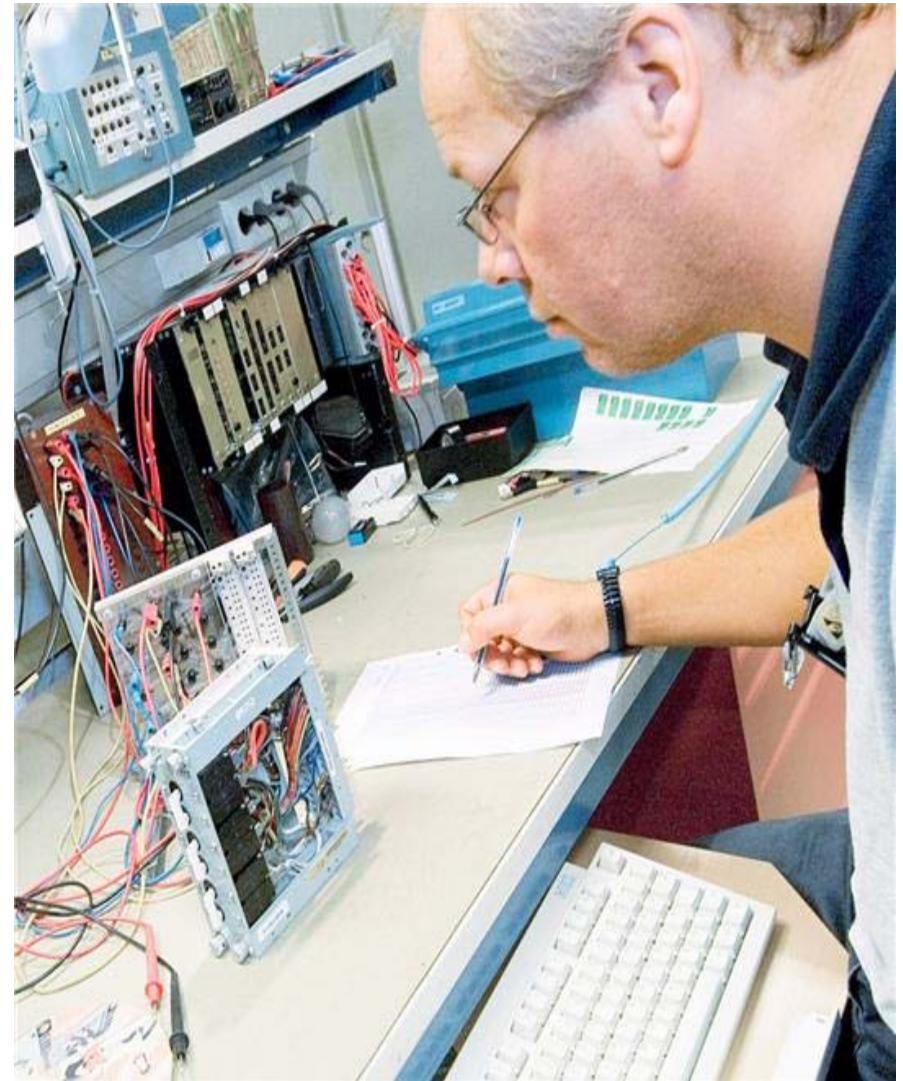
# Special Manufacturing Runs



- Some manufacturers will agree to make a special run of an obsolete product.
- Usually this requires a large volume order, and is often at a special price.
- *C-W Scintech, I&C constantly refreshes their designs to replace unavailable components with equivalent ones – none of our product are ever declared obsolete.*

# Rebuild / Repair

- Repairing existing units is a little more costly, but is often the fastest way to get a functioning unit back in the plant.
- It does require documentation to support troubleshooting and development of test procedures.
- Equivalency evaluations for parts substitutions are usually provided by the repair shop.
- *C-W Sciencetech I&C maintains a fully staffed repair facility, we repair safety and non-safety instrumentation.*



# Cannibalization

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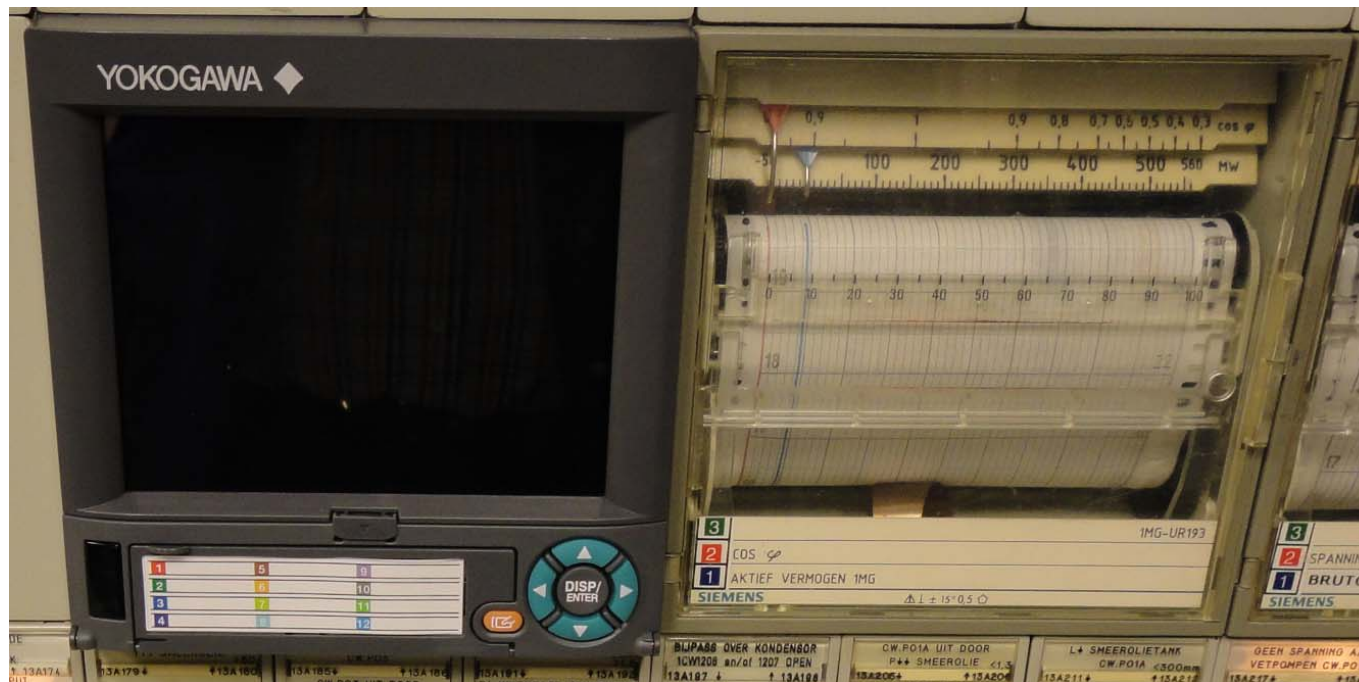
- Cannibalization takes parts from several non-functional units to create one functional unit.
- One drawback, this option requires someone to warehouse the inventory of broken units.
- Another drawback is that the parts cannibalized are not new, so their remaining lifetime is uncertain.
- *C-W Sciencetech prefers and recommends identifying equivalent new parts to support their repair activities.*





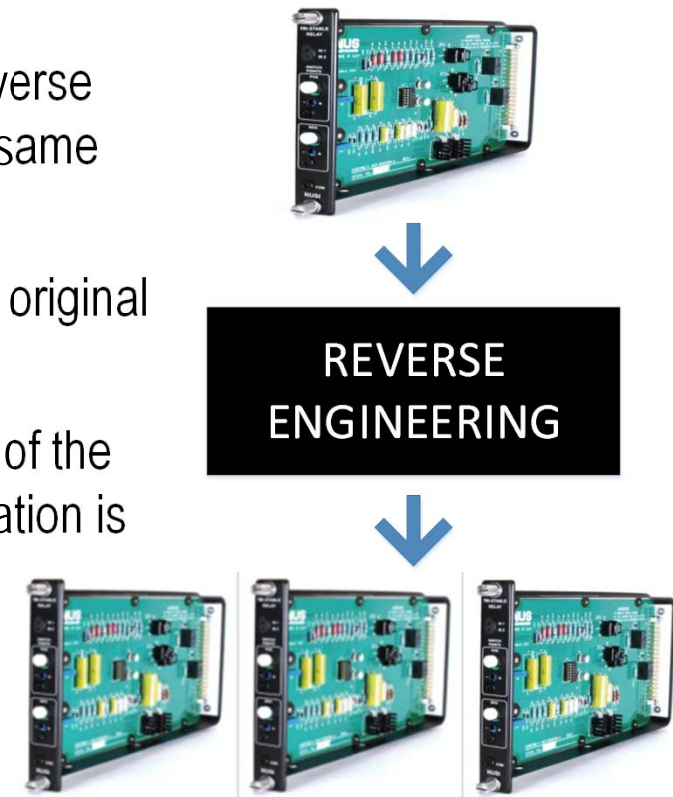
# Substitution

- When the supply chain can't find one, and maintenance can't repair one, it falls to engineering to find a way forward.
- One way is to find similar existing equipment that performs the same function. For most plants, that involves at least a minor modification to the plant paper & procedures.
- *C-W Sciencetech provides assistance in finding substitute I&C equipment.*



# Reverse Engineering

- When existing similar equipment is not available, reverse engineering can produce new components with the same form, fit, and function of the original equipment.
- It can also address any functional problems with the original designs.
- One challenge is to fully document the performance of the existing equipment, as the legacy vendor documentation is often incomplete compared to today's standards.

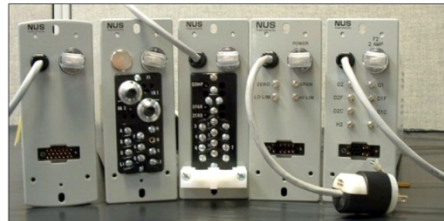


- *C-W Scienteck, is an industry leader in reverse engineering, 100's reverse engineered products are in our current catalog. The following slides summarize some of the reverse engineering project activities.*

# Reverse Engineering – Scientech Components / Equipment

## REPLACEMENTS FOR FOXBORO H-LINE MODULES

- |         |                                      |              |   |
|---------|--------------------------------------|--------------|---|
| ▪ 610A  | Power Supply                         | ▪ 66N        | Signal Characterizer (Function Generator) |
| ▪ 61H   | Indicating Controller                | ▪ 66R        | Lead/Lag Unit                             |
| ▪ 62H   | PID Controller                       | ▪ 66S        | High or Low Signal Selector               |
| ▪ 62HB  | Batch Controller                     | ▪ 67H        | Automatic/Manual Controller               |
| ▪ 62HF  | PID Controller + Remote/Local Switch | ▪ 693A       | Millivolt to Current Converter            |
| ▪ 63U-A | Single Alarm Module                  | ▪ 694A       | Resistance to Current Converter           |
| ▪ 63U-B | Duplex Alarm Module                  | ▪ (various)  | Static Gain Unit                          |
| ▪ 63U-C | Dual Alarm Module                    | ▪ 62H + 66B  | (combined)                                |
| ▪ 63U-D | Deviation Alarm Module               | ▪ 610A + 66B | (combined)                                |
| ▪ 63U-E | Single Difference Alarm Module       |              |   |
| ▪ 63U-F | Duplex Difference Alarm Module       |              |   |
| ▪ 66A   | Square Root Converter                |              |   |
| ▪ 66B   | Current Repeater                     |              |   |
| ▪ 66C   | Summing Amplifier                    |              |   |
| ▪ 66D   | Multiplier / Divider                 |              |   |
| ▪ 66E   | Current Source                       |              |   |
| ▪ 66G   | Voltage to Current Converter         |              |   |
| ▪ 66K   | Integrator                           |              |   |



## REPLACEMENTS FOR HAGAN 7100 MODULES

- |           |  |           |   |
|-----------|--|-----------|---|
| ▪ 103-709 | Signal Isolator                                | ▪ 131-113 | Summator w/ High Signal Select              |
| ▪ 103-504 | Remote/Manual Setpoint Station                 | ▪ 139-118 | Signal Comparator                           |
| ▪ 103-805 | Lead, Lag, and Derivative Amplifier            | ▪ 137-101 | 10-50 ma Loop DC Power Supply               |
| ▪ 125-124 | PID Controller                                 | ▪ 137-121 | 45 volt Loop DC Power Supply (1 to 3 loops) |
| ▪ 125-124 | Remote/Manual Control Station                  | ▪ 137-122 | 40 volt Loop DC Power Supply (1 to 3 loops) |
| ▪ 125-152 | Optimac Lead Lag Controller                    | ▪ 127-113 | Function Generator                          |
| ▪ 127-111 | Analog Computer Element (Multiplier / Divider) | ▪ 111-118 | Millivolt-to-Current Amplifier              |
| ▪ 131-111 | Signal Summator                                | ▪ 139-110 | Hagan/Sigma Magnetic Amplifier Relay        |
| ▪ 131-112 | Summator w/ Low Signal Select                  | ▪ xxx-xxx | Hagan Batch Controller                      |
|           |  | ▪ xxx-xxx | Integrator (voltage to pulse converter)     |



## REPLACEMENTS FOR BAILEY 7000 MODULES

- |        |                       |       |                         |
|--------|-----------------------|-------|-------------------------|
| ▪ 701  | Basic Controller      | ▪ 744 | Single Difference Alarm |
| ▪ 720  | Utility Station       | ▪ 745 | Dual Alarm              |
| ▪ 721  | Blind Controller      | ▪ 745 | Single Alarm            |
| ▪ 722  | Manual Unit           | ▪ 746 | Dual Limiter            |
| ▪ 723  | Proportional & Delay  | ▪ 746 | Single Limiter          |
| ▪ 724  | Logic Unit            | ▪ 750 | Square Root Extractor   |
| ▪ 7401 | Millivolt Converter   | ▪ 752 | Summer                  |
| ▪ 7403 | RTD Converter         | ▪ 754 | Function Generator      |
| ▪ 744  | Dual Difference Alarm | ▪ 755 | Dynamic Compensator     |



## REPLACEMENTS FOR GEMAC 500 MODULES

- |          |   |                  |  |
|----------|---|------------------|--|
| ▪ 540-01 | Basic Controller                        | ▪ 561            | Integrator                             |
| ▪ 542-08 | Manual Loading Station                  | ▪ 562            | Rate Limiter                           |
| ▪ 542-09 | Manual Loading Station                  | ▪ 563-02         | Proportional Amplifier                 |
| ▪ 543-04 | Blind Controller                        | ▪ 563-05         | 5 Input Summer                         |
| ▪ 544    | Controller Manual/Auto Transfer Station | ▪ 564            | Multiplier/Divider                     |
| ▪ 548    | Controller Manual/Auto Station          | ▪ 565            | Square Root Converter                  |
| ▪ 549    | Basic Convertible Controller            | ▪ 566            | Function Generator                     |
| ▪ 550    | Millivolt to Current Converter          | ▪ 567            | Computational Module                   |
| ▪ 560-1  | Single Alarm Module                     | ▪ 570-06         | Isolated Power Supply (1 to 5 outputs) |
| ▪ 560-3  | Dual Alarm Module                       | ▪ GE 194X606G003 | Power Supply                           |





# Reverse Engineering – Sciencetech Components / Equipment

## REPLACEMENTS FOR BAILEY 820 MODULES

- 6623695 Summer+Bias+Inverter Action Unit
- 6623817 Tri-Stable Relay
- 6623819 Signal Monitor
- 6623835 Signal Generator
- 6624080 Multiplier
- 6624120 Signal Lag Action Unit
- 6624125 Derivative Action Unit
- 6624150 Summer Plus Integral Action Unit
- 6624200 Rate Limited Signal Follower Action Unit
- 6624261 Signal Limiter
- 6624505 Square Root Extractor
- 6624543 Auctioneer
- 6624610 Quad Buffer Amp
- 6624665 Function Generator
- 6625070 Power Supply Monitor
- 6625160 Pulser
- 6625621 Voltage-to-Current Converter
- 6629530 Summer+Proportional+Integral Action Unit
- 6629536 Summer+Integral Action Unit



## REPLACEMENTS FOR ROSEMOUNT 710DU MODULES

- 710DU0TT Master Trip Unit, 4-20mA, Standard Reset
- 710DU1TT Master Trip Unit, 4-20mA, Extended Reset
- 710DU0TS Slave Trip Unit, Standard Reset
- 710DU1TS Slave Trip Unit, Extended Reset
- 710DU0TR RTD Input Master Trip Unit, Standard Reset
- 710DU1TR RTD Input Master Trip Unit, Extended Reset
- 710DU0CL Calibration Unit (Seismic Only)
- 710DU0RA1 Readout Assembly Unit
- 710DU0BC Calibration Unit Blank Panel
- 710DU0BT Trip Unit Blank Panel
- 710DU0CF Card File
- 710DU0EC Calibration Unit Extender
- 710DU0ET Master (4-20mA) Trip Unit Extender
- 710DU0ER Master RTD Trip Unit Extender



## REPLACEMENTS FOR ANALOG METERS

- In 2011, Sciencetech I&C acquired the intellectual property for the Versatile Measuring Instruments line of analog meters
- The line includes equivalent meters for
  - Sigma
  - International Instruments
  - Bach-Simpson
  - LFE
  - API
  - Triplette
  - Camille Bauer



## REPLACEMENTS FOR RELAYS

- Sciencetech also acquired the intellectual property for the Lisle-Metrix line of relays, timers, and conductivity products
- The line includes both Lisle-Metrix relays and equivalent relays for
  - AECL
  - Potter Brumfield
  - Agastat
  - Cutler Hammer
  - Klockner-Mohler



MDJ874 - Replaces Agastat 9110, 9110, 9112



MRJ1171 - Replaces Potter & Brumfield JM-3112



MDJ874 - Replaces Aromat and Deutsch Relays



D87 Timer – Replaces Cutler Hammer D87 Series Timers

# Commercial Grade Dedication (CDG)

## Diversity of Equipment Types

Actuator	Damper	Level switches	RTD
Air conditioner	Fan, Vanaxial	Lights	Screws
Alarm relay	Fan-coil unit	Limit switch	Sensor
Analog converter	Filter	MCC unit	Solenoid valve
Batteries	Fitting	Meter	Splices
Bearing, radial	Fuse	Motor	SQ root extractor
Belt	Fuse block	Motor circuit protector	Square root module
Cable	Fusible switches	Pressure switch	Starter
Capacitors	Gasket	Pressure transmitter	Suppression modules
Circuit breaker	Gauge, pressure	Pump	Switch
Clamps	Heat traces	Radiation detector	Tape splice
Compressor	Heater	Recorder	Temperature switch
Conduit seal	Hose, flex	Resistors	Terminal block
Conduit, flexible	HVAC control	Register	Terminal board
Conformal coating	HVAC monitor panels	Regulator	Transformer
Connectors	Hydrogen monitor	Regulator, pressure	Transmitters
Contactors	I/P transducers	Relay	Transducers
Controller	Indicating light	Relay, socket	Valve
Controller, temperature	Indicator	Relay, overload	Voltmeter
Converter, power	Lamps	Relay, timing	
Coupling, flexible	Level detector	Register	

**Commercial-Grade Dedication** - Commercial-grade dedication is a process by which a commercial-grade item (CGI) is designated for use as a basic component. This acceptance process is undertaken to provide reasonable assurance that a CGI to be used as a basic component will perform its intended safety function and, in this respect, is deemed equivalent to an item designed and manufactured under a 10 CFR Part 50, Appendix B, quality assurance program. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses by the purchaser or third-party dedicating entity.



# Commercial Grade Dedication (CDG)



DIN Rail Power Supply



Square Root Converter



ENSIGN Power Supply



Capacitors



Foxboro Replacement Module



PID Controller



# Design Change / Replacement

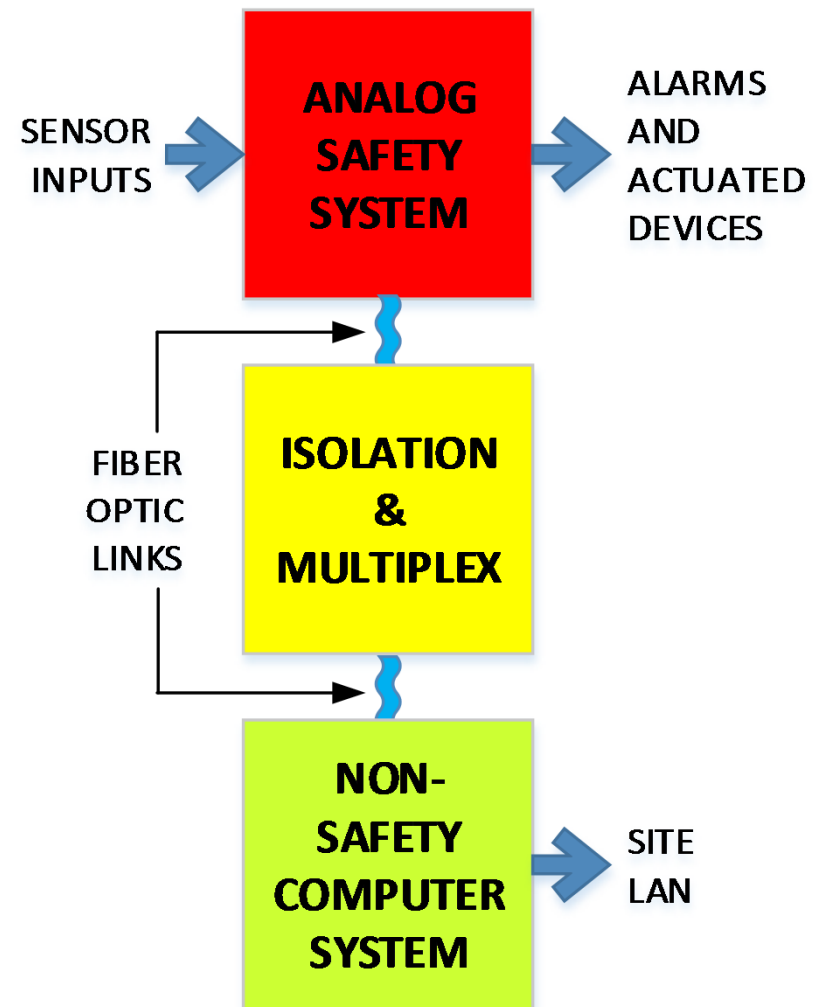
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- Finally, when the equipment or system doesn't support the current or future needs of the plant, it's time to look for replacements
- Design changes are usually the most costly and require the longest schedule of any of the seven options.
- New analog and digital systems are available from several vendors, each with their advantages and disadvantages.
- *C-W Sciencetech offers:*
  - *New Analog Safety Systems*
  - *New Digital Non-Safety Systems*



# Design Change – Analog Safety Systems

- Safety systems use simple functions and have limited human interfaces.
- Analog technology is well suited for safety systems:
  - no software development
  - no cyber security issues
  - no early obsolescence
- Modern opto-isolators easily isolate signals for non-safety use.
- *C-W Sciencetech offers a Modern Analog Safety System (MASS) platform using a modular structure that allows its use in many applications.*



# Design Change – Digital Non-Safety Systems

## ■ Plant Process Control Systems

SIL 2 or 3 Rated System

IEC-61131 Programming Tools

0.9999 System Availability

High speed I/O Performance

Dual and Triple Processor and I/O redundancy

Full Suite of Control Algorithms

Comprehensive Diagnostics Embedded in Design

Industry Proven Robustness

## ■ Plant Process Computers

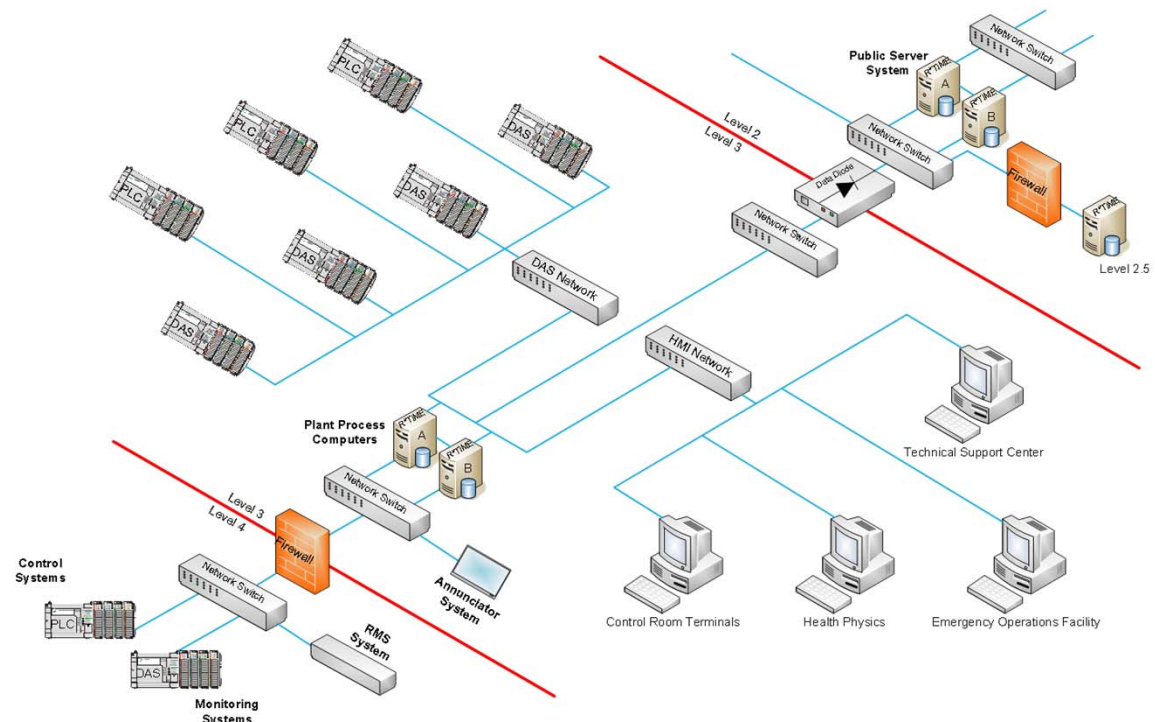
- Uses R\*TIME, our real time operating system

- Performs monitoring & control functions in distributed I/O

- Provides operator Interface, navigation & engineering tools

- Meets and adapts to changing cyber security requirements

- Designed to remain in service through the life of the plant





## Additional Tools to Assist with PLEX Projects

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- RAPID - Readily Available Parts Inventory Database
- OIRD – Obsolescence Item Replacement Database
- EQ Power Suite™ - Equipment Qualification Data Base
- PRA / PSA - Reliability, Availability, and Maintainability Assessment (RAM) and PLEX Associated PRA / PSA Services
- Nuclear Regulatory Services (PLEX Licenses Assistance)
- Inventory Analysis
- Obsolescence Program Assistance

# Contact Information

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Questions ?

Comments?

***Thank You !***

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<http://www.cwnuclear.com>