EXAMPLE

Smart Modernization Refresh

System Assessment Report and Smart Modernization Plan

Prepared For:

Date:
June 18, 2019

by CTI Employee
Sales@controltechnology.com

1.0 Summary

This System Assessment Report and Smart Modernization Proposal is intended to function as a guide to help you in planning for modernization of your existing Simatic® / TI505 PLC systems.

We have done the following:

1. Conducted an audit of the PLC systems in your plant on June 1, 2019. Discussed your current situation, needs, and possible modernization scenarios. Discussed Plant SCADA requirements.

2. Received information about spares in your inventory.

3. Reviewed the results of the audit to identify "at risk" components based on these criteria:
    a. What products are installed and where are the obsolescence and "wear out" risks?
    b. For products with an identified risk, what are the likely failure scenarios?
    c. For products with an identified risk, what are the options for eliminating the risk? Is there a direct replacement, or would there be engineering / electrical work involved?

4. Created a list of recommended minimum spare hardware as well as a cost list to evaluate and/or repair any currently stocked CTI spare hardware.

5. Finally, we've prepared this Smart Modernization Proposal to suggest a phased plan to eliminate the risks and refresh / extend the life of these systems for years to come. The phases are designed to address the problems in order of priority based on criticality of failures.

2.0 System Assessment Report

The PLCs at this facility are used for ***.

The SCADA system used is ***.

The programming software used is ***. You indicated there is concern about the viability of existing program backups.

Problems reported in the last year include:

1. Occasional I/O module failures.
2. Failure of system to restart properly after power-down.
3. Unexplained fatal errors on CPUs.
4. Unknown status of module spares.

Improvements / new features you would like to see include:

1. Want faster response on HMI and SCADA system
2. Want better resolution on analog inputs
3. Need to be able to communicate with variable speed drives using EtherNet/IP in the future

You reported that you would be interested in additional training on Workshop for basic maintenance and troubleshooting.

2.1 RESULTS OF THE EQUIPMENT AUDIT

Your Simatic® / TI505 PLC installation includes the following:

Panel	Item/Description Currently in Use	Manufacturer	Model #	QTY
PLC #1	Rack Power Supply, 100 Watt	CTi	2515	1
	Processor	CTi	2500-C400	1
	24Vdc Digital Input Module	Siemens	505-4332	2
	1/2A DC Digital Output Module	Siemens	505-4532	3
	8 Channel Analog Input Module, Isolated	CTi	2550-A	3
	8 Channel Analog Input Module	Siemens	505-6108-A	7
	Ethernet TCP/IP Module	CTi	2572-A	1
Remote Base 1	Rack Power Supply, 100 Watt	CTi	2515	1
	Profibus Remote Base Controller	CTi	2500-RBC	1
	Universal Digital Input Module	CTi	2589-A	3
	DC Digital Output Module	CTi	2597	2
	8 Channel Analog Input Module, Isolated	CTi	2550-A	4
	Analog Output Module	CTi	2560-A	2
Remote Base 2	Siemens Simatic 505 Power Supply	Siemens	505-6660	1
	Remote base controller	Siemens	505-6851-A	1
	505-4632 Output Module	Siemens	505-4632	1
	505-4232A input Module	Siemens	505-4232-A	2
Remote Base 3	Siemens Simatic 505 Power Supply	Siemens	505-6660	1
	Remote base controller	Siemens	505-6851-A	1
	505-4632 Output Module	Siemens	505-4632	1
	505-4232A input Module	Siemens	505-4232-A	2
Remote Base 4	Siemens Simatic 505 Power Supply	Siemens	505-6660	1
	Remote base controller	Siemens	505-6851-A	1
	505-4632 Output Module	Siemens	505-4632	1
	505-4232A input Module	Siemens	505-4232-A	2
PLC #2	Rack Power Supply, 100 Watt	CTi	2515	1
	Processor	CTi	2500-C400	1
	8 Channel Analog Input Module, Isolated	CTi	2550-A	3
	Analog Output Module	CTi	2560-A	3
	Universal Digital Input Module	CTi	2589-A	3
	Relay Output Module	CTi	2534	3

2.2 RESULTS OF THE INDIVIDUAL COMPONENT REVIEW

We have reviewed the details of your installation, and, based on the discussions we had in the meeting, we recommend a phased approach for modernizing your installation over time.

Our review of the equipment audit data identified the following "at-risk" items (in general order of importance):

1. Power supplies (505-6660) extensively use electrolytic capacitors for energy storage and filtering. As a conservative measure, we recommend replacement of power supplies after 10 years of operation. Your installation includes 12 505-6660 power supplies, which are at least 16 years old, and could be much older than that. These power supplies are operating well past their service life and should be replaced as soon as possible. We rank this priority as "critical / urgent" and suggest this be done in Phase 1 of this modernization.

    a. *Likely failure scenario.* A failure in a power supply will take down an entire base, or if it's the CPU base, the entire system. Although power supplies will occasionally just "go dark", the more likely failure involves gradual degradation due to gradual reduction in energy storage on the capacitors. The end result of this process is a power supply that can no longer "hold up" the 5V to allow time for the PLC to do a normal shutdown when power is lost or removed. When filtering capacitors are affected, more unwanted ripple and noise is transmitted to the backplane, which can cause lots of intermittent and abnormal conditions on I/O modules – especially analog I/O.
    b. *Mitigation options.* These power supplies are easily replaced using the CTI 2512 power supply during a shutdown. The power requirement of your systems is well within the 75W rating of this supply.

2. Relay modules (505-4908 / 4916 / 4932) use electrolytic capacitors which are subject to degradation over time. More importantly, the relay contacts are a wear item. We recommend considering replacement of these modules when any relay on the module reaches 250,000 cycles. We rank this priority as "high" and suggest this be done in Phase 2 of this modernization.

    a. *Likely failure scenario.* Symptoms of relay failure would include failure of outputs to turn on or turn off. These symptoms may be "intermittent" in the beginning, but will increase over time
    b. *Mitigation options.* These relay modules are easily replaced using the appropriate CTI 2534 / 2532 / 2531 relay module during a shutdown. No wiring changes are needed.

3. CPUs (545-1101 and 545-1106) use electrolytic capacitors in their internal power supplies and include complex semiconductors (microprocessors, gate arrays, and memory components) which are more susceptible to accumulated damage from thermal and electrical stress. All CPUs carrying the Texas Instruments or Siemens logos are in excess of 16 years old. We recommend replacing your remaining Siemens CPUs using CTI equivalent products in Phase 3 of this modernization.

    a. *Likely failure scenario*. Failure in the CPU will take down the entire system and is usually critical. CPUs usually just "go dark" when a critical component onboard fails. However, it is not unusual to have "degradation" related failures, which would normally show up as repeated Fatal Errors because of problems in memory chips of the microprocessor. Communications ports are another frequent failure item due to accumulated damage from electrical and ESD transients coming in on attached communication cables.
    b. *Mitigation options.* These CPUs are easily replaced using the CTI 2500-C200 processor during a shutdown. A program reload will be required, so it's important that you have a program backup before starting a CPU replacement. Advantages of CTI processors include better performance, more memory for your programs, built-in Ethernet port, and support for new instructions not available on Siemens / TI processors.

4. Remote Base Controllers (505-6851-A) all use electrolytic capacitors in the internal power supplies. All RBCs carrying the Texas Instruments or Siemens logos are in excess of 16 years old. We recommend replacing your remaining Siemens RBCs using CTI equivalent products in Phase 3 of this modernization.

    a. *Likely failure scenario.* A failure in the RBC will cause an entire base to stop operating, and so it is usually a critical failure. RBC failures are usually "hard failures" i.e. they go off entirely, or they stop communicating with the CPU because of an I/O port failure. It is unusual, but not impossible, to have a degradation or intermittent failure.
    b. *Mitigation options.* RBCs are easily replaced using the CTI 2500-RIO-B RBC. Only the affected base needs to be shut down, so it is often possible to replace an RBC in a running system.

5. Analog I/O modules (505-6108 / 6108-A, 505-6208 / 6208-B, 505-2555) all use electrolytic capacitors in the internal power supplies. We recommend replacing your remaining Siemens Analog I/O modules using CTI equivalent products in Phase 4 of this modernization.

a. *Likely failure scenarios.* As these capacitors degrade, they no longer provide adequate filtering, resulting in both continuous and intermittent errors in the analog readings. Some kinds of failures in the analog signal chips on the module will cause similar errors.
b. *Mitigation options.* These modules are easily replaced using the appropriate CTI analog input or analog output module.

6. Digital I/O modules (505-4216 / 4232-A / 4332 / 4532 / 4632 / 4816) use electrolytic capacitors in their internal power supplies. As these models are often switching high voltages and currents, transients and ESD can cause accumulating damage to the semiconductors over time. We recommend replacing your remaining Siemens digital I/O modules using CTI equivalent products in Phase 5 of this modernization.

    a. *Likely failure scenarios.* These products normally fail in a "hard" manner, i.e. the channel stops working completely. It's not unusual for the remaining channels to continue working normally.
    b. *Mitigation options.* These modules are easily replaced using the appropriate CTI digital I/O module.

7. FUTURE NOTE: I/O Bases (505-6516) do not use any active components. However, over many years it is possible for mechanical damage or corrosion to compromise the reliability of the connectors where the modules plug in. We recommend continuing to monitor these products and making a replacement if/when problems are encountered.

    a. *Likely failure scenarios.* The most frequent failure mode is bent pins on a connector. Less frequently, we see failures due to corrosion on the contacts. These failures can be extremely frustrating to diagnose, because they are usually intermittent. You can isolate the problem to a particular module, unplug and replug the module, and then find everything is working again. Then in a matter of a few minutes or hours, the problem returns.
    b. *Mitigation options.* These bases are easily replaced using the appropriate CTI I/O base. The replacement can be mechanically intensive, as the entire base must be shut down and modules removed before unbolting the old base and installing the new one.

8. FUTURE NOTE: A number of modules in these installations have already been replaced in the past using CTI products. Because we're unable to determine the age of these modules, we have not included a replacement recommendation in this assessment report. However, we recommend continuing to monitor these products and making a replacement if/when problems are encountered.

For more information about reliability and failure modes, see the CTI White Paper “Reliability in Aging Programmable Logic Controller Systems”, available on our web site.

3.0 Smart Modernization Proposal

Based on the results of the System Assessment, this Smart Modernization Proposal gives you a phased plan for modernizing your Simatic / TI505 PLC systems.

Phase One (Critical / Urgent) – Power Supplies

The most important item in Smart Modernization is always power supplies. Your PLC systems include ** 505-6660 power supplies which we recommend replacing ASAP as “Critical / Urgent” items in Phase 1 . A quote is included at the end of this proposal.

Phase Two (High Priority) – Relay Modules

Because relay contacts are a fixed-life item, we recommend replacement of the remaining ** Siemens relay modules (505-4908 / 4916 / 4932) as a “High Priority” item in Phase 2 of the modernization. A quote is included at the end of this proposal.

Phase Three (Medium Priority A) – CPUs and Remote Base Controllers (RBCs)

Because of the critical role CPUs and RBCs in operating the system, we recommend replacement of the remaining * CPUs and * RBCs using CTI 2500-C200 and 2500-RIO-B modules as a “Medium Priority A” item in Phase 3 of the modernization. A quote is included at the end of this proposal.

Phase Four (Medium Priority B) – Analog I/O

A total of * Siemens Analog I/O modules remain in your system. We recommend replacement of these using CTI 2558 and 2562 modules as a “Medium Priority B” item in Phase 4 of the modernization. A quote is included at the end of this proposal.

Phase Five (Low priority) – Digital I/O

A total of * Siemens Digital I/O modules remain in your system. We recommend replacement of these using the appropriate CTI digital I/O modules as a “Low Priority” item in Phase 5 of the modernization. A quote is included at the end of this proposal.

We have based these recommendations for “phasing” of this modernization on a “system-wide” look that considers the risk of failure for each individual module type. However, we understand that it may be preferable to conduct the modernization using an approach that updates an entire plant at a time. If you decide this approach is preferable, we can easily update the quotations in this proposal accordingly.

Spare Hardware Assessment/Repair and Recommended Stock

We received a list of spare hardware currently stocked at each site. It has been stated that the majority of this hardware resides in open packaging and that the condition is unknown. The list of current stock is comprised of both Siemens and CTI hardware. The Siemens hardware is not considered a viable spare due to the age of the hardware. Many of the internal components (electrolytic capacitors, etc.) have a reliable shelf life that has been surpassed regardless of prior duty or use. Included here is a cost list to evaluate or repair each of the currently stocked CTI spare hardware. Evaluation would be $***/module. If a repair is needed and possible to do, the cost of the repair would include the evaluation and not be added to the evaluation cost.

CTi Spare Parts Evaluation/Repair				
Model	**Description**	**Quantity on hand**	**Evaluation**	**Repair**
2512	Rack Power Supply, 75 Watt	1		
2500-C400	Processor	2		
2500-RBC	Profibus Remote Base Controller			
2534	Relay Output Module	1		
2550-A	8 Channel Analog Input Module, Isolated	1		
2555	16 Channel Analog Input Module	2		
2555-A	16 Channel Analog Input Module	1		
2558	8 Channel Analog Input Module	1		
2560-A	Analog Output Module	1		
2589-A	24Vdc Digital Input Module	1		
2597	1/2A DC Digital Output Module	2		
2599	8/16/32 Point AC Output Module	1		

Below is a list of recommended spare hardware for each plant, including cost for each component. We recommend a minimum spare stock of one of each piece of hardware in use on site.

Recommended Spares List				
Plant	**Model**	**Description**	**Min Stock**	**Price**
	2512	Rack Power Supply, 75 Watt	1	
	2500-C400	Processor	1	
	2500-RBC	Profibus Remote Bas[illegible]	1	
	2500-RIO-B	Remote Bas[illegible]	1	
	2534	Relay [illegible]	1	
	2550-A	8 Channel A[illegible] Module, Isolated	1	
	2558	8 [illegible] Analog Input Module	1	
	2560-A	[illegible]nalog Output Module	1	
	2572-B	Ethernet TCP/IP Module	1	
	2589-B	24Vdc Digital Input Module	1	
	2597	1/2A DC Digital Output Module	1	
	2599	8/16/32 Point AC Output Module	1	

4.0 Conclusion

- Your investment in Simatic®/TI505, made long ago, is secure. CTI makes direct replacements for all Siemens products used in the 505 PLC systems at **, and we have no plans to discontinue any of these products.
- CTI continues to invest in products which add modern capabilities to this system. Our products allow you to modernize your installation over time, spreading out the investment, while preserving your intellectual property as embodied in the control system software.
- CTI products are designed and assembled in the USA, at our factory in Knoxville, TN.
- This modernization plan provides a phased approach to updating these systems, while retaining compatibility with your existing plant SCADA, and also supporting future version upgrades.

Quote

Control Technology Inc.
5734 Middlebrook Pike, Knoxville, TN 37921 USA
Phone: +1.865.584.0440 Fax: +1.865.584.5720
www.controltechnology.com

Quote Number
Created Date

Phase 1

Account Name
Mailing Address

Contact Name
Phone
Email

Prepared By
Phone
Email

Product	Product Description	Quantity	Unit Price	Total Price
2512	Power Supply, 120/240VAC 75W	12.00		

Total Price
Grand Total

Terms & Conditions:

Price quoted in USD, FOB Knoxville, TN. CTI Standard Shipment method is UPS Ground, PP&A unless otherwise specified by the customer.

Payment terms are Net 30 days from the date of the invoice.Net 30 Payment Terms require a CTI customer account and credit approval.

Taxes, (if applicable) are extra. Restocking charges may apply in the event of any returns.

This quote is good for 90 days. Prices are subject to change. For product warranty see:

http://controltechnology.com/support/warranty

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Quote Number
Created Date

Phase 2

Account Name

Prepared By
Phone
Email

Product	Product Description	Quantity	Unit Price	Total Price
2531	32 Point Form-A Relay Output	8.00		
2532	16 Point Form-A Relay Output	4.00		
2534	8 Point Form-C Relay Output	8.00		

Total Price
Grand Total

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Quote Number

Created Date

Phase 3

Account Name

Prepared By

Phone

Email

Product	Product Description	Quantity	Unit Price	Total Price
2500-C200	CPU, 256K	2.00		
2500-RIO-B	RS485 Remote Base Controller	10.00		

Total Pr

Grand Total

Terms & Conditions:

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Quote Number

Created Date

Phase 4

Account Name

Prepared By

Phone

Email

Product	Product Description	Quantity	Unit Price	Total Price
2555-A	16 Channel Analog Input	1.00		
2558	8 Channel Analog Input	11.00		
2562	8 Channel Analog Output	4.00		

Total Price

Grand Total

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www.controltechnology.com

Quote Number
Created Date

Phase 5

Account Name

Prepared By
Phone
Email

Product	Product Description	Quantity	Unit Price	Total Price
2589-B	8/16/32 Point Universal Digital Input	30.00		
2597	8/16/32 Point DC Output	3.00		
2599	8/16/32 Point AC Output	3.00		

Total Price
Grand Total

Terms & Conditions:

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