Apprenticeship Related Supplemental Instruction (RSI) Plan Review

Program Sponsor: **LOTT Alliance Apprenticeship Committee #291**

Skilled Occupational Objective(s): **Control Systems Technician**

Term: **6000 hours**

Total RSI Hours: **432 minimum**

Training Provider: **Multiple**

1. L&I Coordinator meets with Sponsor, and Training Provider to develop RSI Plan

Alice M. Curtis	**Alice M. Curtis**
Signature of L&I Coordinator	**Print Name**

2. The program sponsor agrees to provide the prescribed RSI training for each of the registered apprentices

Laurie Pierce	**Laurie Pierce**
Signature of Program Sponsor	**Print Name**

3. RSI will be conducted by instructors who meet the qualifications set forth in WAC 131-16-070 through –095

Laurie Pierce	**Laurie Pierce**
Signature of Training Provider	**Print Name**
Facilities Manager	
Title	

4. Date: **6-29-06** Reviewed by L&I Program Manager (submitted 45 days prior to WSATC Quarterly Meeting)

Karen L Carter	**Karen L. Carter**
Signature of L&I Program Manager	**Print Name**

5. The trade committee makes a recommendation to the SBCTC about the relevance of the instruction

Signature	Print Name	Date
Ardis E Benson	Ardis E. Benson	7-5-06

6. Date: **7-5-06** Reviewed by Trade Committee and agrees RSI Plan is reasonably consistent with other RSI Plans for the industry

William Bowser	**William Bowser**
Signature of Trade Committee Chair	**Print Name**

7. Date: **7-5-06** RSI Plan reviewed by the State Board for Community and Technical Colleges

Pat Ward	**Pat Ward**
Signature for SBCTC	**Print Name**

8. Date: _____ Sent by SBCTC to WSATC with recommendation

Apprenticeship RSI Plan

NOTE: The description of each element should be in sufficient detail to provide adequate information for review by the SBCTC.

Element: **Industrial Electronics/PLC I**	Planned Hours **24**
Description of Program: **This Programmable Logic Contoller (PLC) training course serves as an introduction to the concepts of programming logic controllers and explains how PLC's can be used in a plant or manufacturing system. This PLC training course is based on practical applications and experience in using programmable logic controllers in the workplace. Enables students to use programmable logic controllers to solve machine and process problems. Terminology is reviewed as well as basic PLC concepts.** IMT 215 Clover Park Technical College or equivalent course	

Element: **IE/PLC I – Lab**	Planned Hours **22**
Description of Program: **Lab goes with the PLC I course above.** IMT 220 Clover Park Technical College or equivalent course	

Element: **Industrial Electronics/PLC II**	Planned Hours **24**
Description of Program: **Advanced industrial electronics/programmable logic controllers, computer operations, terminology, trouble-shooting and programmable logic controller interface as applied to the technical manufacturing maintenance trades.** IMT 225 Clover Park Technical College or equivalent course	

Element: **IE/PLC II – Lab**	Planned Hours **35**
Description of Program: **Lab goes with PLC II course above** IMT 230 Clover Park Technical College or equivalent course	

The following courses are from the TPC Training Systems

Element: **101 Reading Blueprints**	Planned Hours **20**
Description of Program: **Covers all types of blueprints used in industrial plants. Discusses machine parts and machine drawings. Features drawings of a compound rest and a clutch-brake control. Examines hydraulic, pneumatic, piping, plumbing, electrical, air-conditioning, and refrigeration drawings. Introduces sketching used in industrial plants.**	

Element: **102 Reading Schematics & Symbols**	Planned Hours **20**
Description of Program: **Covers all types of schematics and symbols used in commercial and industrial settings. Examines symbols on schematics, electrical symbols and diagrams, piping symbols and diagrams, hydraulic and pneumatic diagrams and symbols. Discusses air conditioning and refrigeration systems, including explanations of electrical/electronic control schematics. Covers welding and joining symbols.**	

Element: **103 Using Mathematics in the Plant**	Planned Hours **20**
Description of Program: **Begins by introducing mathematical basics—numbers and numerals, subtraction, addition, multiplication, and division. Examines common fractions and decimal fractions, ratios and proportions, powers and roots. Discusses the calculator: usage, basic and special functions, internal logic, and special purpose calculators. Moves on to cover geometry, algebra, and formulas for problem solving. Concludes by explaining properties of triangles and trig and inverse trig functions.**	

Element: **104 Making Measurements**	Planned Hours **20**
Description of Program: **Covers units of measurement used in commercial and industrial applications. Examines all aspects of basic measurement concepts and procedures, including accuracy and tolerance. Discusses techniques and devices for comparison measurements (dial indicators and gauge blocks). Shows common methods for measuring volume, motion, force, temperature, fluid flow, and electricity. Explains how to use scales and rules, combination calipers, and micrometers.**	

Element: **105 Working with Metals in the Plant**	Planned Hours **20**
Description of Program: **Introduces metals, metallurgy, and metalworking. Discusses the properties of metals, including their** **mechanical properties. Examines several industrial manufacturing processes. Covers iron and standard steels. Explains the different kinds of heat treatment and their usage. Discusses some techniques of working with copper, aluminum, magnesium, titanium, lead, nickel, tin, and zinc.**	

Element: **106 Working with Nonmetals in the Plant**	Planned Hours **20**
Description of Program: **Introduces major nonmetal materials and how they are most frequently used. Describes properties, characteristics, and classifications of each material. Covers synthetic and natural materials. Examines various paints and coatings, their proper use, preparation, and application. Surveys industrial chemicals. Chemical safety precautions are covered, along with the proper use of protective equipment.**	

Element: **107 Using Hand Tools**	Planned Hours **20**
Description of Program: **Covers the most important hand tools used on the job. Begins with measuring tools, including a discussion of units of measurement. Examines the various kinds of wrenches and screwdrivers, their uses and handling techniques. Explains other hand tools by specialty: pipefitting tools, plumbing tools, electrician's tools, sheet metalworking tools, machinists' metal-working tools. Ends with hoisting and pulling tools.**	

Element: **108 Using Portable Power Tools**	Planned Hours **20**
Description of Program: **Explains the uses, selection, safety, and care of industrial power tools: electric drills, electric hammers, pneumatic drills and hammers, screwdrivers, nutrunners, wrenches, linear-motion and circular saws, routers and planes, electric sanders, grinders, and shears. Covers tool sharpening techniques for selected tools.**	

Element: **110 Developing Troubleshooting Skills**	Planned Hours **20**
Description of Program: **Explores the subject of troubleshooting and the importance of proper maintenance procedures. Covers working with others, aids in communication, and trade responsibilities. Outlines troubleshooting techniques and aids, using schematics and symbols. Focuses on specific maintenance tasks, breakdown maintenance, and planned maintenance.**	

Element: **201 Understanding Basic Electricity & Electronics**	Planned Hours **20**
Description of Program: **Covers basic, nonmathematical approach to understanding principles of electricity. Introduces electron theory, static electricity, electrons in motion, and magnetism. Covers basic methods of measuring current, voltage, and resistance. Explains circuit components— conductors, insulators, resistors, capacitors—and simple Ohm's Law calculations for DC and AC circuits.**	

Element: **202 Batteries and DC Circuits**	Planned Hours **20**
Description of Program: **Covers how electrochemical action is used. Covers batteries, electrolytic action, electroplating, Characteristics of storage batteries, application and maintenance of lead-acid, nickel-alkaline, and nickel-cadmium batteries, putting batteries into service, charging batteries, maintaining records, fundamentals of DC circuits, and using Ohm's Law to solve problems in DC series, parallel, and series-parallel circuits.**	

Element: **203 Transformers and AC Circuits**	Planned Hours **20**
Description of Program: **Covers differences between DC and AC circuits. Explains AC sine wave, using vectors to solve AC problems, calculating impedance in circuits having inductance, capacitance, and resistance, AC power relationships in single-phase and three-phase circuits, and principles of transformer maintenance.**	

Element: **204.1 Electrical Measuring Instruments**	Planned Hours **10**
Description of Program: **Covers the principles on which electrical test instruments operate. Basic instruments covered include voltmeter, ammeter, wattmeter, ohmmeter, and megohmmeter. Covers AC metering, split-core ammeter, use of current and potential transformers. Includes detailed coverage of modern multimeters. Explains functions and uses of oscilloscopes.**	

Element: **205.1 Electrical Safety and Protection**	Planned Hours **10**
Description of Program: **Examines electrical hazards and stresses the importance of electrical safety. Covers the equipment and procedures necessary to work safely with electricity, including PPE, lockout/tagout, and first aid. Explains the importance of grounding. Describes many kinds of fuses, circuit breakers, and motor protection devices and their uses.**	

Element: **206 DC Equipment and Controls**	Planned Hours **20**
Description of Program: **Covers DC power applications in industry, types of DC generators, operating characteristics of DC motors, DC armature principles, and armature maintenance and repair. Includes types of DC relays, DC controllers, overspeed and overload protection, drum and reversing controllers, dynamic braking, DC power supplies, diodes, semiconductors, SCR principles, and DC maintenance practices.**	

Element: **207 Single-Phase Motors**	Planned Hours **20**
Description of Program: **Covers the types and operating principles of common single-phase motors. Explains NEMA motor standards. Explains how to identify motor leads on split-phase, capacitor-start, capacitor-run, permanent split capacitor, and repulsion motors. Also covers universal motors, shaded-pole motors, and other special types, including synchro and servo systems. Gives general maintenance procedures on all single-phase motors.**	

Element: **208 Three-Phase Motors**	Planned Hours **20**
Description of Program: **Covers three-phase motor principles for induction, synchronous, and multi-speed dual-voltage motors. Gives recommended maintenance practices for large AC motors. Covers principles of three-phase motor starters, part winding, reversing, jogging, alternator principles and operation. Describes three-phase power distribution.**	

Element: **209 AC Control Equipment**	Planned Hours **20**
Description of Program: **Covers the broad range of industrial motor starting and control equipment, including NEMA sizes and ratings. Includes pushbutton control stations, limit switches, mercury switches, mechanical and magnetic plugging, foot switches, and pressure, temperature, and float switches. Covers control panel wiring and special applications.**	

Element: **210 Electrical Troubleshooting**	Planned Hours **20**
Description of Program: **Covers use of schematic diagrams, determining sequence of operation, and use of building diagrams and single-line diagrams. Includes troubleshooting procedures for control circuits and combination starters. Explains troubleshooting practices on DC and AC motors, identifying unmarked leads on three-phase delta and Y-connected motors, and troubleshooting lighting systems.**	

Element: **251 Semiconductors**	Planned Hours **10**
Description of Program: **Covers the theory behind semiconductor operation. Describes the characteristics and operation of various diodes and transistors. Stresses the importance of proper environmental conditions and explains how to minimize electrostatic discharge (ESD) and radio frequency interference (RFI). Discusses printed circuit board (PCB) and integrated circuit (IC) technology, including connection and replacement methods. Identifies kinds of semiconductor packages. Explains how to interpret manufacturers' spec sheets and how to analyze circuit performance by Q points and characteristics.**	

Element: **252 Power Supplies**	Planned Hours **12**
Description of Program: **Covers the four basic kinds of power supply conversions. Explains how to work with nonchemical cells as well as primary and secondary cells of various materials. Describes in detail the functions and operation of several kinds of rectifiers, filters, and voltage regulators and explains how they work together as power conditioners. Discusses basic tools, test devices, and procedures for troubleshooting to solve the greatest number of problems in the least amount of time.**	

Element: **253 Amplifiers**	Planned Hours **10**
Description of Program: **Covers the effects of gain, bandwidth, and distortion on amplifier performance. Compares linear and nonlinear (switching) amplifiers. Explains how to use transistor curves to analyze amplifier operation in terms of operating regions, load lines, operating (Q) points, and biasing. Discusses impedance matching and compares capacitive, transformer, and direct-coupled amplifiers. Describes many ways op amps are used today, including integrators and comparators. Provides specific methods for troubleshooting common amplifier problems.**	

Element: **254 Oscillators**	Planned Hours **10**
Description of Program: **Covers how oscillation is started and maintained. Compares LC (tuned), RC (phase-shift), and crystal oscillators. Compares sine-wave oscillators and square-wave switching circuits. Discusses monostable, astable, and bistable flip-flop operation in detail and shows expected waveforms. Explains how logic clocks are generated and conditioned. Discusses Schmitt trigger circuits, frequency dividers, and ripple counters, as well as propagation delays and glitches. Describes the operation of low-pass, high-pass, band-pass, and band-reject filters, including differentiators and integrators. Describes the equipment and procedures for troubleshooting oscillator components and circuits.**	

Element: **291 Digital Logic Systems**	Planned Hours **10**
Description of Program: **Covers the comparison of analog and digital switching circuits. Explains Boolean logic functions. Describes TTL and CMOS logic, as well as IC logic devices. Explains how flip-flops, clock circuits, counters, multiplexers, and memory circuits work. Describes the sections and interfaces in functional logic systems, including microprocessors. Describes proper methods for detection and correction of common fault potentials.**	

Element: **261 Introduction to Computers (user level)**	Planned Hours **10**
Description of Program: **Covers a brief history of the computer and defines fundamental computer terms. Introduces the binary and hexadecimal number systems. Explains the different levels of programming languages. Describes microprocessor characteristics and architecture in general terms. Concludes with examples of practical applications.**	

Element: **262 Input/Output devices (user level)**	Planned Hours **10**
Description of Program: **Covers many of the input/output devices that make up a typical computer system. Explores communication-the successful transmission of information between computers-at length. Discusses both the user/machine interface and the machine/machine interface, as well as the various network configurations. Concludes with two "real-world" examples of how microprocessors are connected to I/O devices.**	

Element: **266 How Computers Function (technician level)**	Planned Hours **10**
Description of Program: **Covers the function and basic operation of each major element of a microprocessor. Explains the structure and purpose of various computer buses. Examines characteristics of different types of main memory in detail. Includes in-depth discussion of both low- and high-level computer languages.**	

Element: **267 Input/Output Devices II**	Planned Hours **10**
Description of Program: **Covers more fully many of the input/output devices introduced in Course 262. Describes various magnetic and optical memory devices, including tapes, disks (hard and floppy), and CD-ROMs. Explains how signals are converted from analog form to digital form, and vice versa. Covers data acquisition systems and common digital transmission standards. Defines the error detection techniques used to ensure the accurate transmission of digital data. Describes various types of digital transmission equipment, such as modems and fiber optics. Concludes with a practical application that combines all of the principles presented in previous lessons.**	

Element: **268 Maintaining/Troubleshooting Computer Systems**	Planned Hours **10**
Description of Program: **Covers the maintenance of microprocessor-based equipment, including preventive maintenance. Describes diagnostic procedures and takes a "hands-on" look at many types of test equipment, including oscilloscopes, logic analyzers, and in-circuit emulators. Emphasizes the importance of thorough documentation in all areas. Discusses general troubleshooting guidelines and covers troubleshooting aids and accessories.**	

Element: **271 Introduction to Process Control**	Planned Hours **12**
Description of Program: **Covers the function of basic devices for measuring and controlling different kinds of variables in process control. Introduces closed-loop control and PID functions. Introduces analog and digital devices and programmable logic controllers (PLCs). ISA and SAMA instrumentation symbols and interpretation and use of process diagrams are covered.**	

Element: **272 Foundations of Measurement Instrumentation**	Planned Hours **10**
Description of Program: **Covers basic principles of measurement and defines process control terms. Describes several kinds of signals and displays and traces the path of a signal through the system. Explains the operation of transducers, transmitters, signal conditioners, converters, and recorders. Discusses specification details, conversion between English and SI units, calibration methods, and the maintenance of records.**	

Element: **273 Pressure Measurement**	Planned Hours **10**
Description of Program: **Covers units of pressure and discusses Boyle's and Charles' laws to explain relationships among pressure, volume, and temperature. Describes sensor operation of manometers, bourdon tubes, diaphragms, and bellows. Explains the operation of potentiometric, capacitive, reluctive, servo, strain-gauge, and piezoelectric transducers. Describes devices used in low-pressure control. Discusses proper and safe methods for installing and servicing pressure instruments.**	

Element: **274 Force, Weight, and Motion Measurement**	Planned Hours **10**
Description of Program: **Covers force, stress, and strain and explains the operation of strain-gauge systems. Relates weight to mass and scales to balances. Explains the operation of load-cell scales. Describes belt-scale, nuclear-scale, and weigh feeder operation. Covers position measurements by means of proximity detection, air gauging, LVDT gauges, synchros, code disks, and other devices. Explains machine tool control and accelerometer operation. Describes the measurement of angular velocity and acceleration, vibration detection, and machinery balancing.**	

Element: **275 Flow Measurement**	Planned Hours **20**
Description of Program: **Covers principles of fluid flow and how primary devices affect fluid flow. Describes flow measurement using several kinds of secondary devices. Discusses rotameters and other variable-area instruments. Explains how weirs, flumes, and other arrangements measure open-channel flow. Compares many kinds of positive-displacement meters and explains the operation of several kinds of turbine and magnetic flowmeters. Describes less-common flowmeters (including vortex-precession, mass flow, and ultrasonic devices) and instruments that meter the flow of solids. Provides guidelines for safe installation and maintenance of flow devices.**	

Element: **276 Level Measurement**	Planned Hours **10**
Description of Program: **Covers principles governing various methods of measuring level. Explains operation of conductive, capacitive, resistive, ultrasonic, and photoelectric devices. Compares the operation of several kinds of pressure-head instruments. Explains the measurement of solids by ultrasonic, microwave, radiation, and other methods. Discusses several special-application devices for both continuous and point level measurement.**	

Element: **277 Temperature Measurement**	Planned Hours **10**
Description of Program: **Covers units in thermal measurement and operation of RTDs (and wheatstone bridges), thermistors, and thermocouples and thermometers. Includes principles of pyrometry and operation of narrowband, broadband, and bandpass pyrometers. Discusses calibration standards, typical calibrating methods, and instrument testing.**	

Element: **278 Analytical Instrumentation**	Planned Hours **10**
Description of Program: **Covers principles, installation, calibration, and maintenance of conductivity probes, and methods of stack gas monitoring. Includes how to install, calibrate, and maintain pH and ORP measurement instruments and operation, installation, calibration, and maintenance of several optical analyzers. Discusses principles and safe practices governing sensors used in measuring oxygen, carbon monoxide, carbon dioxide, and other products of combustion. Concludes with operation, calibration, and system components in liquid and gas chromatography.**	

Element: **279 Final Control Elements**	Planned Hours **10**
Description of Program: **Covers how elements in a closed-loop system affect final control element. Describes components in final control subsystems. Discusses operations of solenoids, motors, relay systems, and PLCs. Explains pneumatic actuators and positioners. Describes mechanical advantage in several hydraulic control systems. Compares construction, characteristics, and applications of eight control valves. Traces operation of each element in typical feedwater, turbine, and robotic control systems.**	

Element: **280 Safety, Calibrations and Testing Procedures**	Planned Hours **10**
Description of Program: **Covers the responsibilities of employer, employee, and regulatory agencies in maintaining safety. Discusses ways of identifying and handling chemical, electrical, biological, radiation, and mechanical hazards. Discusses importance of maintenance (including calibration) and proper record keeping. Describes use of common electrical and electronic test instruments. Offers guidelines for handling heavy equipment, decontaminating and servicing pneumatic and hydraulic equipment, and troubleshooting.**	

Element: **281 Working with Controllers**	Planned Hours **10**
Description of Program: **Covers the purposes and kinds of controllers and their relationship to other components in process control systems. Explains the concepts of current-, position-, and time-proportioning control. Compares the operation of several kinds of controllers. Describes the operation of proportional, integral, and derivative modes, and discusses tuning procedures for each. Discusses cascade, feedforward, ratio, and auctioneering control systems as well as other operations. Describes ways to eliminate or reduce controller problems.**	

Element: **282 How Control Loops Operate**	Planned Hours **10**
Description of Program: **Covers definition of control loop terms and characteristics. Includes specific examples of operation of control loops of many kinds. Discusses proportional, integral, and derivative modes in detail. Describes advanced control methods by means of four strategies with specific examples. Examines the effects of loop dynamics on system stability.**	

Element: **283 Data Transmission**	Planned Hours **10**
Description of Program: **Covers mechanical, hydraulic, pneumatic, and telemetric data transmission methods. Discusses indicators, other devices, and methods used for electrical/electronic data transmission in detail. Compares methods and standards for parallel and serial digital data transmission. Describes optical isolation and the operation of optical data transmission systems in detail. Provides specific methods for preventing common kinds of data transmission interference.**	

Element: **284 Computers in Process Control**	Planned Hours **10**
Description of Program: **Covers the evolution of today's process control computer systems. Compares smart components to older conventional system devices. Covers the architecture (hardware and software), configuration, and operation of distributed control systems in depth (two entire lessons) by using as an example a typical DCS controlling an ice cream plant. Defines common terms used in today's integrated plant and discusses the integration of discrete and continuous processes with plant business functions.**	

The following training is specific training seminars
From Metso Automation/Max System Training

Element: **TPP101 maxDNA Legacy System Overview**	Planned Hours **40**
Description of Program: **The TPP101 introduces the student to system architecture and capabilities. It also includes the material needed by students following a migration upgrade path. The course contains a summary of system components, general introduction to the workstation, basic configuration techniques, and a brief introduction to graphic design. This course is also useful for management personnel who wish to have a better understanding of the system capabilities and requirements.**	

Element: **TPP410 maxDNA Legacy System Maintenance**	Planned Hours **40**
Description of Program: **The TPP410 course provides hands on experience related to installation, calibration, and system hardware troubleshooting. The internal components of the workstation are described to aid in diagnosing problems and installing replacements. The conformation of the network and DPUBUS components are analyzed for aid in diagnostics and troubleshooting. The DPU, Controller Files, and I/O modules are presented for calibration and replacement.**	

Element: **TPP311 maxDNA Legacy maxVvue Graphics Design**	Planned Hours **40**
Description of Program: **The TPP311 introduces the student to the basic principles of Human Machine Interfacing, screen organization and screen design. It covers the basic drawing tools and the MAXVUE ActiveX (OCX) controls. The student is taught how to enhance and supplement the standard controls using WrapperCalcs, and maxSCRIPT.**	

From Rockwell Automation Systems

Element: **CCP146 ControlLogix System Fundamentals**	Planned Hours **16**
Description of Program: **Course is a skill-building opportunity for students who want to develop a solid fundamental knowledge of Logix5000 systems and terminology. Students will be introduced to Logix5000 system components and functionality and will have an opportunity to use RSLogix 5000 software to perform basic system networking and configuration tasks.**	

Element: **CCCL21 RSLogix Basic Ladder Logic Interpretation**	Planned Hours **16**
Description of Program: **Course is a skill-building course that provided maintainers with a basic understanding of RSLogix 5000 ladder logic instructions and terminology. This course also provides the resources and hands-on practice required to efficiently modify basic ladder logic instructions for a Logix5000 controller. Students will use RSLogix 5000 software to perform basic software tasks.**	

Element: **CCP153 ControlLogix Maintenance & Troubleshooting**	Planned Hours **32**
Description of Program: **Course provides student with information and experience to efficiently interpret, troubleshoot, and recommend a course of action for a Logix5000 application in a downtime situation. Resources and hands-on practice are provided in order to interpret, isolate, and diagnose common control system hardware problems related to noise, power, and digital and analog I/O.**	

Element: **CCP151 RSLogix 5000 Basic Ladder Logix Program'g**	Planned Hours **16**
Description of Program: **Course provides programmers with a basic understanding of RSLogix 5000 ladder logic instructions and terminology. Resources and hands-on practice are provided to program basic ladder logic instructions for a Logix5000 controller. Students will use RS Logic 5000 software to perform basic software tasks to meet the requirements of a given functional specification.**	

Element: **CCP422 DeviceNet Maintenance & Troubleshooting**	Planned Hours **16**
Description of Program: **Course prepares students to return a malfunctioning DeviceNet network to normal operation and complete basic hardware and software maintenance tasks with minimum downtime. Students will practice the tasks necessary to add and replace network devices and return a malfunctioning DeviceNet network to normal operation.**	

Element: **CCP200 RSView32 Project Maintenance**	Planned Hours **32**
Description of Program: **Course is designed to provide student with the skills needed to maintain and modify an RSView32 human-machine interface (HMI) automation project used to control and monitor an operation. Students will use RSView32 software to practice the tasks associated with maintaining an existing RSView32 project by modifying functionality and features.**	