WBS NUMBER					TITLE	DESCRIPTION
1	**2**	**3**	**4**	**5**		
1	**02**				INJECTOR SYSTEM	The injector generates the electron beam and accelerates it to 135 MeV. This system includes the laser, optical transport, the electron gun, the accelerator sections, the solenoids and other magnets, the diagnostics including a diagnostic section at the end of the injector, the LCLS timing system, and the laser room. The interface to the Linac is at the downstream end of Dog Leg 1 (DL1), ending at the valve at the entrance to linac section L1.
1	**02**	**01**			Injector System Management & Integration	At level 3 of the WBS the Injector System is divided into 17 discrete systems. Each of these systems can have multiple functional requirements that range from local and sub system, to Linac, LCLS project, and then SLAC. This section of WBS identifies these interdependencies, supports the establishment of consistent and hierarchical requirements, and supports systems that manage and integrate these efforts. Requirements and planning for Injector installation is covered in this section.
1	**02**	**01**	**01**		Injector System Integration	This section provides engineering and design support for the entire Injector system. This section addresses common system requirements for the Injector Vault, Shielding Walls, and Linac Insertion areas.
1	**02**	**01**	**01**	**01**	Injector Region Integration	This section provides engineering and design support for the entire Injector system. This section addresses common system requirements for the Injector Vault, Shielding Walls, and Linac Insertion areas.
1	**02**	**01**	**01**	**02**	Gun Area Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**01**	**03**	Accelerator Area Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**01**	**04**	Heater Area Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**01**	**05**	Wall Area Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**01**	**06**	Insertion Area Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**01**	**07**	Spectrometer Area Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**01**	**08**	Drive Laser Integration	This section provides engineering and design support for this specific sub assembly of the Injector system. The interfaces between this mechanical sub assembly and the Injector vault are reviewed and or addressed in this section.
1	**02**	**01**	**04**		Injector System Integration Effort / M&S	This element covers the costs over the entire Injector for materials and supplies through the PED and Construction phase of the project. Specific categories are identified; Travel, Computers, Cost Account Management, as well as general Management.

WBS NUMBER					TITLE	DESCRIPTION
1	**2**	**3**	**4**	**5**		
1	**02**	**02**			Injector Controls Subsystem	The injector controls system is to be an EPICS – Experimental Physics and Industrial Control System. The Injector control system must interface with the existing linear accelerator (LINAC) timing system. Local system control, at Sector 20, will be used for development through the commissioning phase of the project. Operational control will reside in the LCLS Main Control Center (MCC).
1	**02**	**02**	**01**		Personnel Protection Subsystem (PPS)	This section covers the cost of designing and writing software to integrate the new EPICS Control system with the existing accelerator PPS control system.
1	**02**	**02**	**02**		Beam Containment Subsystem (BCS)	This section covers the cost of designing and writing software to integrate the new EPICS Control system with the existing accelerator BCS control system.
1	**02**	**02**	**03**		Machine Protection Subsystem (MPS)	This section covers the cost of designing and writing software to integrate the new EPICS Control system with the existing accelerator MPS control system.
1	**02**	**02**	**04**		Injector Power Conversion	Provide all instances of the magnet power supply system for the Injector.
1	**02**	**02**	**04**	**01**	Beamline Pwr Supplies - (Dipole Type)	Provide all instances of the magnet power supply system for the Injector.
1	**02**	**02**	**04**	**02**	Power Supply Controls	Provide all instances of the magnet power supply system for the Injector.
1	**02**	**02**	**04**	**03**	Beamline Pwr Supplies - (Trim Type)	Provide all instances of the magnet power supply system for the Injector.
1	**02**	**02**	**04**	**04**	Beamline Pwr Supply - Misc Hdwr	Provide all instances of the magnet power supply system for the Injector.
1	**02**	**02**	**05**		LLRF Controls	Provide all instances of the LLRF system for the Injector.
1	**02**	**02**	**05**	**01**	Readback & Controls - RF Gun LLRF & Temperature	Provide all instances of the LLRF supply system for the Injector.
1	**02**	**02**	**05**	**02**	Readback & Controls - L0 LLRF	Provide all instances of the LLRF supply system for the Injector.
1	**02**	**02**	**05**	**03**	Readback & Controls - Transverse Cavity LLRF	Provide all instances of the LLRF supply system for the Injector.
1	**02**	**02**	**05**	**04**	S-Band Cavity Controls	Provide all instances of the LLRF supply system for the Injector.
1	**02**	**02**	**06**		E-Beam Diagnostics Controls	Provide all instances of the E-Beam Diagnostics for the Injector.
1	**02**	**02**	**06**	**02**	Controls - BPM	The BPM (Beam Position Monitor) controls for the injector consist of the cables from the BPM hardware to the local VME crate, along with the controller, license and software to communicate with the BPM.
1	**02**	**02**	**06**	**03**	Controls - Toroids	Toroid (current monitor) controls include the cables from the hardware to the control modules in the VME crates, the VME control modules and the software to communicate with the toroids. The crate, controller and license are included in section 1.2.2.8.
1	**02**	**02**	**06**	**05**	Controls - Profile Monitors	There are two types of profile monitors: YAGs (where energy is low) and Optical Thermal Radiators (OTR) (where energy is higher). Controls include the camera and accompanying PC (ratio of cameras: PC may > 1), the Cables between each and the Ethernet cable to get data to MCC, along with software for interpreting the image data.
1	**02**	**02**	**06**	**06**	Controls - E/O Diagnostics	The electro-optic phase diagnostic consists of an analog signal of pulse length measurements which will be input into an ADC VME module in the diagnostics crate or via a digitizer. Software in the IOC will calculate the centroid of the array of pulse lengths, and from that, due to the linear relationship between the chirped pulses' length and time, determine the relative time between the electron and the laser beam. The result will be converted to an analog signal via a DAC VME module which will be used to vary the drive laser signal such that the relative time goes to zero. This same result will also be used to vary the gun phase such that the relative time goes to zero.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	02	06	14	Controls - Faraday Cups	There are four Faraday Cups in the LCLS injector. Each contains its own OTR or YAG profile monitor. Where the energy is low, a YAG is used; where the energy is high, an OTR is used. Where the Faraday Cup is used to momentarily intercept the electron beam, a pneumatic actuator is used to insert the FC/PM assembly.
1	02	02	06	15	Controls - Tune-Up Dump	Tune up dump controls include the cables from the hardware to the control modules in the VME crates, the VME control modules and the software to communicate with the toroids. The crate, controller and license are included in section 1.2.2.8.
1	02	02	08		Timing Controls	One master timing controller is needed for the injector. This controller interfaces to the LINAC's Main Drive Line (MDL) and passes on the timing signals to a maximum of 8 outputs. The fiducial output (FIDO) module divides the 476 MHz signal by 4 to become a 119 MHz signal (8.4 nsec ticks). The FIDO sends its signal to the PDU II module in the VME crate of the receiving system. It uses Heliax cable between the FIDO and the PDU II.
1	02	02	09		Vacuum Controls	The vacuum design for the waveguide is based on the vacuum design at LINAC sector 2. Controllers, power supplies, gauges, valves, and cables are identified in this system. The pumps are small ion pumps, equally spaced along the waveguide. The pump power supplies are controlled via set points sent via VME IDIM signals. Two kinds of gauge controllers will be used. The Pirani and the Cold Cathode gauges are controlled by a HPS 937 gauge controller; the hot filament gauges are controlled by a GP307 Ion gauge controller. During the design phase, the number of each type of gauge used will be determined. There are 4 valves. All 4 valves can be controlled by a single programmable multi valve controller, PMVC6, module. Faston relays are also used to control the valves.
1	02	02	10		Software & Controls Infrastructure	Application development environment, control crates, control CPUs for the Injector controls.
1	02	02	10	03	Data Communications	Controls workstations will have access to MCC from the control room and from the RF hut. The network will be configured to get images to MCC without compromising control commands. Laptops will have wireless access to the visitor network. Access points will be at both the ground and subground levels.
1	02	02	10	04	Computers & Crates	The VME crates with Power PC IOC controller and VxWorks.
1	02	02	12		Laser Controls	Controls for the Injector Laser provided by the vendor.
1	02	02	12	02	Controls - Gun Laser	This element includes costs for the design and documentation of local control and the interface of the Gun Laser to the main control system.
1	02	02	13		Laser Heater Controls	The laser heater controls system consists of control modules, cables and software to do on/off control of two laser shutters one in beam conditioning optics, one at launch table. Steer the IR beam by controlling two motorized mirror stages on the launch table. Modifying the OTR control, if necessary, for the laser heater. Transmit the IR joulemeter signal from IR diagnostics to MCC. There are 4 analog signals which need to get to PEP via an ADC. There might be 0.5 months software work here, too. Transmit the IR timing diode signal to an oscilloscope near diagnostics port. Transmit the Spiricon camera image on the diagnostic table to MCC and receive controls from MCC. Transmit the electron beam energy spread data from OTR and to MCC. A PC might be needed here for the spectrometer. Reduce the data for the laser and the e-beam (the previous two items). Control the Undulator by stepping the motor and reading the position from LVDT sensors and the limit switches.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	03			Injector Lasers	The drive laser system provides ultraviolet (UV) irradiation to the cathode of the LCLS RF photoinjector. The drive laser utilizes a standard chirped pulse amplification (CPA) design beginning with a mode-locked infrared (ir) oscillator. Oscillator pulses are temporally shaped and stretched before entering the IR amplifier chain. This chain amplifies the single pulse energy in two sections (i) the preamplifier and (ii) the final amplifier. Ir pulse energies of order 10's of millijoules are obtained during the final amplification where the repetition rate is also reduced to 120 Hz, the RF photoinjector design repetition rate. Following amplification and repetition rate reduction, a portion of the IR pulse energy is converted to UV irradiation via third harmonic generation in nonlinear media. UV pulse energies of a few millijoules are generated, conditioned, and transported to the photocathode.
1	02	03	01		Drive Laser Support	Drive Laser Support augments the Drive Laser System (1.2.3.2) with additional expertise from ANL and LLNL.
1	02	03	01	01	Drive Laser Support (ANL)	This section covers work for the Injector Drive Laser done at ANL.
1	02	03	01	02	Drive Laser Support (LLNL)	This section covers work for the Injector Drive Laser done at LLNL.
1	02	03	02		Drive Laser System	The drive laser system is the ultimate source of optical irradiation for driving the LCLS RF photoinjector. The drive laser could be a chirped pulse amplification (CPA) scheme using TiS as the gain medium. A mode-locked master oscillator will operate at a 119 MHz repetition rate with a proposed central wavelength of 755 nm. Oscillator timing is referenced (and locked) to an external (SLAC) RF source. Oscillator establishes the maximum single pulse infrared (IR) bandwidth available to the drive laser system. Samples of the oscillator pulse energy can be used for diagnostics and diagnostic probe beams. The final high energy IR pulses will be produced via high gain broad band amplification of phase locked oscillator pulses through an amplifier chain.
1	02	03	02		Drive Laser System (Continued)	The system includes the temporal IR pulse shaper which is intended to alter the temporal shape of the pulse exiting the oscillator from a nominally Gaussian temporal envelope to a nominally flattop (rectangular) envelope with specified steepness for rise and fall edges. Given the nominal rectangular envelope requirement, this device then establishes the duration (FWHM) and shape of the final high energy IR pulse to be used for UV conversion. Final IR pulses can be converted to UV pulses via third harmonic generation. The drive laser system including temporal pulse shaping and UV conversion will be built by an outside vendor. SLAC personnel will participate in the technical reviews and acceptance tests of all stages of the laser system.
1	02	03	03		Drive Laser Diagnostics	The drive laser diagnostics includes several diagnostics clusters for each stage of the system: oscillator, preamplifier, final amplifier and UV conversion. Special ultra-fast high resolution diagnostics for the waveform (temporal shape) measurements will be designed by LLNL. The oscillator diagnostic cluster is intended to monitor the intrinsic oscillator output as well as the results of temporal pulse shaping and stretching. The diagnostic cluster includes a spatial profile imaging system, a fast photodiode, an average power sensor, a time-integrated spectrometer for monitoring bandwidth as well as mode-locked operation, and broadband time-resolved diagnostics for monitoring temporal pulse-width and shape (using techniques such as scanning autocorrelation and frequency-resolved optical-gating (FROG) detection). Where possible, diagnostics require only a sample of the oscillator pulse energy.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	**02**	**03**	**03**		Drive Laser Diagnostics	The preamplifier diagnostic cluster is intended to monitor the preamplifier output. It includes fast photodiode detection, a pulse energy/power meter, spatial profile imaging, and broadband single pulse detection (as would be provided, for example, by polarization-gated frequency-resolved optical-gating detection (PG-FROG)). This single pulse broadband time-resolved detection monitors the temporal pulse shape (envelope) that is established between the preamplifier and the oscillator.
1	**02**	**03**	**03**		Drive Laser Diagnostics	Final amplifier diagnostics is used to monitor the final amplifier output prior to UV conversion. It includes fast diode detection, a time-integrating spectrometer, spatial profile imaging, energy/power sensors, and broadband time-resolved single pulse diagnostics, with potential to add a single-pass oscillator probe beam. As with the preamplifier, single pulse broadband detection is used to monitor the established temporal pulse shape (envelope) with all amplifier effects included.
1	**02**	**03**	**03**		Drive Laser Diagnostics	The UV diagnostic cluster is located at the harmonic generation unit and monitors the UV pulse features prior to transport to the photocathode in the tunnel. It includes a fast photodiode, a pulse energy/power monitor, a time-integrated spectrometer, spatial profile imaging, and single pulse broadband time-resolved UV pulse detection (which will include a streak camera).
1	**02**	**03**	**04**		Timing Stability Monitoring	Timing stability is measured after the oscillator relative to an external SLAC RF source.
1	**02**	**03**	**05**		Steering Stability Feedback & Msmts	Optical beam steering stability is measured after oscillator, final amplifier and UV transport. UV steering stability measuring system is located in the tunnel next to the photocathode and its signal serves as the input to the feedback providing the active stabilization of the beam position.
1	**02**	**03**	**06**		Pre Amp Low Power Comp	The low power compressor recompresses the pre-amplified, stretched and shaped ir pulses back to the shaped level (i.e. without the stretching). It consists of a pair of optical gratings and a mirror prism that returns the beam at a different elevation. The compressed result facilitates monitoring temporal pulse shape, as programmed between the oscillator and preamplifier, to include preamplifier effects. It is monitored at the preamplifier exit using the broadband single pulse diagnostic with adequate temporal resolution (such as the PG-FROG). Using the repetition rate sample of the preamplifier output the low power diagnostic compressor can be used in this way without sampling part of the pulse energy that seeds the final amplifier. Provision can also made for potentially shaping ir pulses at the preamplifier energy level.
1	**02**	**03**	**07**		Transport to Tunnel & Relay Optics	Transport system refers to the system transmitting UV, visible and IR beams over the extended distance from the output of the Drive laser to the tunnel. UV beam is transmitted to the photocathode launch system, IR beam – to the Laser Heater and visible beam – to the EO diagnostics. Transport system incorporates the long vertical transport tubes with evacuation capabilities that extend from the laser bay to the tunnel. The relay optics is included in the system. Spatial filters will be used as needed. Spatial filter consists of a positive lens pair with a filtering on-axis pinhole placed between them. Due to the high pulse energy the space between lenses must be evacuated.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	03	08		UV Launch, Conditioning & Diagnostics	Important UV pulse conditioning issues (for photcathode irradiation) that finally bring the UV pulse parameters into compliance with the LCLS injector specifications are included here. These include final adjustments to temporal profile shaping at the IR oscillator level, spatial profile shaping and spatial filtering, the performance of UV launch optics near the gun photocathode, and electron beam-based UV pulse energy control. Spatial profile filtering and shaping are accomplished together by combining a UV 'flattener' with an input spot size selection using positive lenses. Grating-based launch optics set the required time slew and spatial anamorphic compression.
1	02	03	08		UV Launch, Conditioning & Diagnostics	The electron beam-based UV pulse energy control unit is a polarized optics assembly with a waveplate that can be tuned (via rotation) according to the electron bunch charge level. UV Launch and Conditioning system includes the components, which implement the beam steering and control of the beam size on the photocathode. The spatial profile and filtering as well as UV launch optics are set up along side the gun photocathode at the end of the UV transport section. The additional temporal shape control is implemented between the oscillator and preamplifier. The UV pulse energy control is located in the laser bay within the UV transport section and near the harmonic generation unit.
1	02	03	08		UV Launch, Conditioning & Diagnostics	The potential for final UV beam steering stabilization also exists here. Diagnostics refer to the cluster located at the gun site near the photocathode in the tunnel. This cluster is to provide a final characterization of the UV pulse before irradiating the photocathode and incorporates the virtual cathode concept. It includes a fast photodiode, spatial profile imaging (incident and specular reflection from the photocathode), UV energy/power detection (incident and potentially specular reflection from the photocathode), and single pulse broadband time-resolved detection as needed.
1	02	03	09		Load Lock Transport System	Load Lock Transport system refers to the transport of UV light from the output of the Drive Laser to the Load Lock room, where the cathode processing is performed. The system contains evacuated transport tubes, supports, mirrors and imaging optics.
1	02	03	10		Visible Optical Transport & Optics	Visible light transport refers to the transport of second harmonic light from the harmonic generation unit to a diagnostic site along the gun electron beamline. For example, the visible beam can be used for electro-optic electron beam diagnostics. This includes beam properties, relayed beam paths and enclosures. As such, the long vertical transport tube extending from the laser bay down to the tunnel is part of this section.
1	02	03	10		Visible Optical Transport & Optics	Visible transport diagnostics include fast photodiode and pulse energy detection both at the harmonic generation unit end and at the diagnostic site end in the tunnel along the electron beamline. Spatial profile imaging and broadband time-resolved detection can be incorporated on a need basis.
1	02	03	11		LB Infrastructure & LB System Wide Items	Drive laser system-wide components are included here. This includes, optical tables (in the laser bay and in the injector tunnel) and equipment for the Laser Bay and Optical Alignment Lab. Important laser-related reviews and preparation of the laser safety documents are also included here.
1	02	03	12		Alignment Laser	The alignment laser is a visible CW diode source located along side the gun photocathode near the end of the UV transport section. Its purpose is to establish and to verify electron beam alignment down the evacuated electron beamline of the injector. This section includes the required steering and collimating optics (and required mounting hardware) that are located outside the vacuum beamline.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	03	13		Light path to Streak Camera	This broad-band, visible optical path takes light from a prompt Cherenkov view screen in the gun-to-linac region and images it onto the slit of a streak camera in the laser bay. Its purpose is to measure the electron beam bunch shape. The path optics should be imaging in order to measure transverse-longitudinal correlations between the bunch shape and time. The system includes lenses and mirrors and optical mounts, an alignment laser, mechanical supports and enclosures.
1	02	03	14		LSR HTR - Beam Conditioning Optics (Laser Bay)	This system includes the optics downstream from the dichroic beam separator to the first mirror in the optics transport system down to the linac tunnel. These optics will be on the drive laser table. The subsystems include a grating pair pulse compressor, a collimating telescope, a path length adjustor, and a shutter. Establishment of the optical principles required to prepare the IR beam from the drive laser and deliver it to the transport system. Establishment of all the optical parameters and requirements, and performance of modeling calculations (Zemax).
1	02	03	14		LSR HTR - Beam Conditioning Optics (Laser Bay)	Preparation of a schematic layout with optical components. Identification of commercial optics to be used for beam conditioning, and placement of purchase orders for them. Also, expediting, receipt, and checking of items on receipt. The arrangement of the beam conditioning optics on the drive laser optics bench, their alignment and verification of operation to the point of departure into the transport system.
1	02	03	15		LSR HTR - Transport Optics (Bay to Tunnel)	The transport optics starts at the deflecting mirror that guides the beam from the laser bay into transport tubes to the launch table. The system will include: HeNe laser on beam conditioning table for alignment with dichroic mirror. Input mirror, mount and enclosure. Three transport tubes, with windows and valves for pumpout. Two deflecting mirrors between each tube with mount, adjusting stage, and enclosure, with flip in crosshairs for alignment.
1	02	03	15		LSR HTR - Transport Optics (Bay to Tunnel)	An optics table to mount the launch optics with isolation legs and dust enclosure. A reducing telescope on the launch table and half-wave plate. A window into the e-beam pipe and mirror on manual adjustor to deflect beam into the undulator. This mirror may be focusing. Establishment of optical principles and strategy for beam transport, including model calculations. (Zemax) Dimensioned drawing of entire transport system.
1	02	03	15		LSR HTR - Transport Optics (Bay to Tunnel)	Identification of commercial optics to be used for transport system and placement of purchase orders for them. Also, expediting, receipt, and checking of items on receipt. The arrangement of the beam transport optics, their alignment and verification of operation to the point of departure into the undulator chicane. This should be done using the beam that is delivered from the beam conditioning system. Design of enclosures and tubes so that the transported beam travels mostly in low vacuum piping. Where it exits the piping to be redirected by mirrors, the mirrors will be provided with dust and air current protections.
1	02	03	15		LSR HTR - Transport Optics (Bay to Tunnel)	Purchase or fabrication of an enclosure for the beam where it enters and exits each tube, and a set of evacuable transport tubes. These tubes can be evacuated to low vacuum, valved off, and the vacuum pumps detached. Assembly of the tubes and enclosures, and installation into the injector area.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	03	16		LSR HTR - Photon Beam Diagnostics	Overall engineering design of the system that includes a power meter, a profile camera, and a timing diode, with appropriate optics on a small table downstream from the IR beam - e-beam interaction region. The system will include: Spiricon camera for beam profile monitoring. Coherent power meter for beam power monitoring. Timing diode for local timing measurements. Optics, table and enclosure at end of beamline, including shielding from e-beam radiation. Identification of commercial optics to be used for diagnostics and placement of purchase orders for them. Also, expediting, receipt, and checking of items on receipt.
1	02	03	16		LSR HTR - Photon Beam Diagnostics	An imaging system that will provide transverse beam profiles to be transmitted to MCC. A joule meter capable of transmitting power information to MCC. A fast photodiode and an oscilloscope (10 GHz) to monitor temporal characteristics of the IR laser pulse. The oscilloscope will have to be placed near the diode in use, and removed during accelerator operations. A support table for the diagnostics breadboard. Spare equipment for any diagnostics optics which, if it failed, would prevent the operation of the laser heater. No items identified at present. Installation of the photon diagnostics, and testing of the optics with live beam from the beam conditioning, and transport systems.
1	02	03	21		UV Conv Harmonic Generation Unit (Closed Account)	
1	02	04			Injector RF Subsystem	System Summary
1	02	04	01		RF Gun & Load Lock	The RF Gun is at the north end of the Sector 20 alcove. This section covers all of the mechanical system associated with the operation of the gun and any cathode replacement scheme.
1	02	04	01	01	RF Gun	This section specifically includes the copper brazed gun with a cathode, laser windows, and motorized tuners. It is similar to the GTF gun with an added second RF feed, see drawing SA-290-330-04-REV-1. This device will require cooling water (special), temperature sensors, tuner controls, vacuum, clean nitrogen gas, RF power, and laser light.
1	02	04	01	02	RF Gun Supports	The RF Gun Support is at the north end of the Sector 20 Alcove. This section includes the small support between the gun and a larger table under the GTL area.
1	02	04	01	03	Gun Load Lock	The Gun Load Lock is just upstream of the RF gun in the Sector 20 alcove. This section includes the cathode clamping hardware, the load lock chamber, the cathode transfer mechanism, the external alignment rail system, and the load lock transportation cart. This device will require cooling water (special), vacuum, and clean nitrogen gas.
1	02	04	01	04	Gun Load Lock Supports	The Gun Load Lock Support is at the north end of the Sector 20 Alcove. This section includes the small support between the load lock assembly and a larger table under the GTL area.
1	02	04	01	05	Gun Solenoid	The Gun Solenoid is just downstream of the RF gun in the Sector 20 alcove. This section includes the solenoid magnet similar to the one in GTF, see drawing SA-290-330-64-REV-1, with a skew quad added to the inner bore. This device will require cooling water (LCW), temperature sensors, and electrical power.
1	02	04	01	06	Gun Solenoid Supports	The Gun Solenoid Support is at the north end of the Sector 20 Alcove. This section includes the small support between the solenoid and a larger table under the GTL area.
1	02	04	01	07	Gun RF Feed	The Gun RF Feed is just above the RF gun in the Sector 20 alcove. This section includes a circulator, like a Titan TBC284D007 filled with SF6, two RF windows, and a RF splitter, similar to SA-700-870-66. This device will require SF6 and vacuum.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	04	01	08	Gun RF Feed Supports	The Gun RF Feed Support is at the north end of the Sector 20 Alcove. This section includes the small support between the RF feed and a larger table under the GTL area.
1	02	04	02		Cathode Processing (CP) Station	The cathode processing station is located in the control building above the Injector Vault. This system is where final preparation of gun cathodes will occur prior to installation in replacement guns or the Load Lock System.
1	02	04	02	01	CP Cathode Assembly & Supports	The CP Cathode Assembly & Supports are in the load lock room of the of the Sector 20 LCLS facilities. This section includes a chamber or method of storing cathodes and their supports. This device will require vacuum and clean nitrogen gas.
1	02	04	02	02	CP Load Lock	The GP Load Lock is in the load lock room of the of the Sector 20 LCLS facilities. This section includes the load lock hardware. This device will require vacuum and clean nitrogen gas. The load lock should be compatibly with the RF gun load lock.
1	02	04	02	03	CP Load Lock Supports	The GP Load Lock Support is in the load lock room of the of the Sector 20 LCLS facilities. This section includes the load lock support hardware and transportation cart. The GP load lock support should be compatibly with the RF gun load lock.
1	02	04	02	04	CP Station	The GP Cathode Processing Chamber is in the load lock room of the of the Sector 20 LCLS facilities. This section includes the chamber to dock the load lock and process the cathode. This device will require laser light, diagnostic electronics, vacuum monitoring, vacuum and clean nitrogen gas.
1	02	04	02	05	Cathode Lab Infrastructure	The GP Lab Infrastructure is in the load lock room of the of the Sector 20 LCLS facilities. This section includes the tools necessary to work on and process a cathode before insertion into the RF gun.
1	02	04	03		S-Band Low Level Timing	LLRF system consists of the RF components, less than 10kW in peak power, required to maintain 70fS stability for the injector electronics. The scope of work includes the following: Modifications to the front end RF and timing system of the SLAC main linac, to achieve 70fS stability. A low phase noise LCLS frequency source and distribution system located at the LCLS injector. RF phase and amplitude monitors including the heliax cables connected to the high power WR284 waveguide adapters. RF phase and amplitude control and drive amplifiers up to the 1kW input of the 5045 klystrons. Beam phase monitor system to include beamline device, all electronics and cables. User interface software and algorithm development for feedback loops.
1	02	04	03	01	Controls Interface & Timing	The existing timing and RF distribution system for the two mile linac starts in sector 0 of the linac. The 476MHz Master Oscillator gets a timing pulse superimposed on it and drives the 2 mile Main Drive Line, MDL. Modifications to the RF system start with a lower phase noise master oscillator. The timing system will also be upgraded to meet the LCLS requirements. The output of this system will drive the 2 mile MDL with 30 watts at 476MHz.
1	02	04	03	02	LLRF Phase Reference System	The phase reference system will include locking of a low noise oscillator to the linac RF reference. The 476 MHz reference will be multiplied to 2856MHz and distributed to the laser, RF gun, L0-1, L0-2, transverse accelerator, L1-X and L1-S drive and monitoring systems. Electronics for interfacing to the LASER phase lock. The electronics will be housed in a temperature controlled room enclosing penetration 20-17, which all the phase critical heliax cables will be run down.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	04	03	03	LLRF Monitor & Control System	Design and development of an RF phase and amplitude detector to measure the RF at the output of several high power waveguide couplers. Heliax cables are included here to connect to the high power waveguide couplers. Design and development of a solid state 1kW S-band amplifier to drive a 5045. Design and development of the RF control system used to adjust phase and amplitude of the high power RF components. Control cables to connect to modules in a control create are also included here.
1	02	04	03	04	Beam Phase Monitor Cavity	Development of a beam phase monitoring system. The desired sensitivity of this system is about 50fS on a single pulse. Includes the beam line component, RF detectors, and interfaces to the control system. All electronics and cables up to the control create modules are included here.
1	02	04	03	05	RF System S/W Development / Docs	Development of software tools and user interfaces required to run the LCLS RF system. This will include development of algorithms for feedback loops. Documentation will be complete enough to enable the system to be maintained by the AMRF group.
1	02	04	05		Injector RF Waveguide Subsystem	The INJECTOR RF WAVEGUIDE is located and extends through three different areas: the sector 20 injector alcove, the main LINAC housing, and the klystron gallery. It is split into four systems each fed from a separate klystron. The systems feed the GUN, each of two injector accelerator sections and one transverse kicker section. Three of the systems travel down the ceiling of the klystron gallery, down through a LINAC housing penetration into the main LINAC housing and through the shield wall into the sector 20 injector alcove. The fourth system travels down the LINAC housing and through the shield wall into the sector 20 injector alcove. The systems require vacuum pumping, temperature controlled water and controls feedback. The RF waveguide transports microwave energy from the klystrons to injector beam line components
1	02	04	05	01	RF Waveguides	RF Waveguide includes the costs to design, fabricate, and test discrete sections of UHV High Power S-Band copper Waveguide for the Injector. This section also includes all integral support strong backs, and vacuum hardware in support of the installed system.
1	02	04	05	02	RF Waveguide Supports	Supports cover all fixed and dynamic connection between the waveguide, waveguide pumps and the associated enclosure. (Klystron Gallery, Penetration, Linac Housing, and Injector Vault).
1	02	04	06		Injector Linac Structures	System Summary
1	02	04	06	01	L0-1 Structure Assembly	The LO-1 LINAC section is mounted on the major tube support directly after the gun spectrometer in the sector 20 alcove. This is the first booster section after the gun and is surrounded by a solenoid magnet. This device will require controlled temperature water, temperature sensors, electronics and RF waveguide power from a klystron. It also has a load attached to it and RF couplers for feedback. There is a set of flexures and a strong back support attached to the section. This is the first stage for boosting the beam energy in the injector area.
1	02	04	06	03	Major Linac Support	The MAJOR LINAC is located under the accelerator sections after the gun area and before the first shield wall in the sector 20 alcove. This device gives the major support for the LINAC boost section of the injector. It also acts to stabilize the boost system with respect to vibration and thermal variation.
1	02	04	06	05	LTDL1 RF Kicker	The LTDL1 RF KICKER is located just after the LASER heater and before the first shield wall in the Sector 20 alcove. This device will require supports, a RF waveguide feed and feedback coupler along with the necessary electronics. It will momentarily deflect the beam to measure the longitudinal phase space parameters.
1	02	05			Injector Magnets & Supports	This section collects all of the Injector magnets and their associated local supports and alignment hardware.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	**02**	**05**	**01**		Injector Dipoles	All bending magnets necessary for the Injector System.
1	**02**	**05**	**01**	**01**	GS Dipole	The GS Dipole is just downstream of the RF gun in the Sector 20 alcove. This section includes a dipole magnet and its support. This device will require cooling water (LCW), temperature sensors, and electrical power. It will be used to bend the beam about 90 degrees to measure the beam energy. It needs to have zero residual field when turned off - this may require special trim coils.
1	**02**	**05**	**01**	**02**	DL1 B01 & B02 Dipoles	The DL1 B01 & B02 DIPOLES are located in the LINAC housing at the point where the injector beam turns to match the main LINAC beam line. This section includes the two dipole magnets and location adjustment supports. These magnets will require cooling water (LCW), temperature sensors, and electrical power supplies. They will bend the beam 35 degrees to match the main LINAC beam trajectory. The magnets require zero residual field when switched off - this will be accomplished using the trim coils.
1	**02**	**05**	**01**	**03**	SAB Spectrometer Dipole	The SAB Dipole is located at the end of the straight section of the injector in the main LINAC housing. This section includes a dipole magnet and its support. This device will require cooling water (LCW), temperature sensors, and an electrical power supply. It will be used to bend the beam about 35 degrees to measure the beam energy. It acts as a beam diagnostic device.
1	**02**	**05**	**01**	**04**	Chicane DIPOLES (4)	The chicane magnets are part of the laser heater system. They comprise a four-magnet bump that displaces the electron beam by 25 mm through an undulator. The displacement is to allow an infrared laser beam to be co-propagated with the electron beam in the undulator, in order to increase the uncorrelated energy spread of the electron beam. This has the effect of smoothing micro-instabilities in the beam to reduce enhancement of these instabilities in the bunch compressors. The downstream pair of magnets in the chicane help to transform the energy gained from the laser interaction into geometrical smoothing.
1	**02**	**05**	**02**		Injector Quads	All focusing and defocusing magnets necessary for the Injector System.
1	**02**	**05**	**02**	**01**	GS Quadrupoles	The GS quad magnets are just downstream of the RF gun in the Sector 20 alcove. Two are just before the spectrometer dipole and one is just to the side of the spectrometer dipole. This section includes 3 quad magnets and their supports. These devices will require cooling water (LCW), temperature sensors, and electrical power.
1	**02**	**05**	**02**	**02**	Injector Quadrupoles	This is a single model of Injector System Quadrupole that is used in multiple locations throughout the Injector System.
1	**02**	**05**	**03**		Injector Steering Coils	All Steering Coils necessary for the Injector System.
1	**02**	**05**	**03**	**01**	Gun Solenoid Correctors	These are sets of steering correction coils that are integral with the Gun solenoid.
1	**02**	**05**	**03**	**02**	Gun Spectrometer Correctors	These are sets of steering correction coils that are integral with the Gun Spectrometer.
1	**02**	**05**	**03**	**03**	Injector Correctors - A	These are sets of general use steering correction coils for use in the Injector System
1	**02**	**05**	**03**	**04**	Injector Correctors - D (Gun)	These are sets of general use steering correction coils for use in the Injector System.
1	**02**	**05**	**03**	**05**	GS Quadrupole Correctors	These are sets of general use steering correction coils integral with the Gun Spectrometer Quadrupole.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
1	02	05	04		Linac & Gun Solenoids	The Gun Solenoid is just downstream of the RF gun in the Sector 20 alcove. This section includes the solenoid magnet similar to the one in GTF, see drawing SA-290-330-64-REV-1, with a skew quad added to the inner bore. This device will require cooling water (LCW), temperature sensors, and electrical power. The LINAC Solenoid is mounted over the input end of LO-1. This solenoid magnet is similar in function to the one located in the CID area of the main linac. This device will require cooling water (LCW), temperature sensors, and electrical power. The solenoid acts to focus and collect the beam.
1	02	05	05		Injector Laser Heater Subsystem	This is a system designed to add uncorrelated energy to the LCLS beam in the injector, at 150 MeV, by crossing an IR laser beam with the electron beam in an undulator. The system starts just past from a dichroic beam splitter that is downstream from the drive laser doubling crystals. The IR beam that is not absorbed by the doubling crystals passes through an optics system on the drive laser table, down to the linac tunnel, into the electron beamline, along the electron beam in a chicane, and out into a diagnostic system at the end.
1	02	05	05	01	System Design & Optimization (LSR HTR)	System Design and Optimization consists of developing the physical models for the laser beam / electron beam interaction. This category also includes an overall system design review and reviews by safety committees at SLAC. Definition of the overall parameters, (e.g. undulator length and period, laser beam power and wavelength, beam size and shape) needed to obtain the desired energy modulation. The desired energy modulation is determined beam dynamics models for the FEL as a whole. Refinement of the parameters, and integration of the laser heater into the rest of the injector. A design review of the laser heater subsystem of the injector; with some participation outside of SLAC. This review is in addition to a separate review for the undulator proper. Safety reviews for electrical, earthquake, laser optics, radiation, and mechanical hazards. These reviews will be done by internal SLAC committees.
1	02	05	05	02	Injector Undulator	A variable gap hybrid undulator 1 meter or shorter in length, with 50 mm period and 28 mm gap that is intended to give the injector beam transverse motion to allow it to couple to a co-propagating IR laser beam. Establishment of the physical, mechanical, magnetic, and beam dynamic parameters of the undulator, and generation of a technical description suitable for presentation to vendors for RFQ. A design review of the undulator that will consider its physics, mechanical and magnet engineering, and the modeling from which the various parameters were developed. This review should include some participation from outside SLAC. An assembly level drawing of the undulator; more refined designs will come from the vendor if the undulator is built outside, or from further SLAC designs if we build it here.
1	02	05	05	02	Injector Undulator (Continued)	Choice of internal or external construction. If internal construction is chosen, selection of personnel to do the work, and supervision of the work. If external construction is chosen, sending of bid packages, choice of vendor, possible vendor design review, supervision of contract, expediting and checking of item on receipt. If the undulator is awkward or difficult to install, rigging must be designed to put it into place. This requirement is much reduced as of placement of the undulator upstream from the shielding walls. Fabrication of any rigging required for emplacement of undulator. Measurements by the SLAC magnetic measurements group of the magnetic fields of the undulator, to verify that the device meets its specifications. This work will also include calibration of trim coils provided to cancel the earth's field and any residual dipole errors.

WBS NUMBER					TITLE	DESCRIPTION
1	**2**	**3**	**4**	**5**		
1	**02**	**06**			Injector Vacuum & Supports	Summary of all vacuum system component and support costs as outlined by the general ICD.
1	**02**	**06**	**01**		Injector Vacuum Engineering	All engineering associated with the design, fabrication, planning and oversight for the Injector Vacuum System
1	**02**	**06**	**02**		Injector Vacuum Components	Covers the cost of general components. (gages, pumps, valves, feedthroughs, and other commercial vacuum components)
1	**02**	**06**	**03**		Injector Vacuum Special Chambers	This section covers the cost of design and fabrication of special chambers not associated and covered by a specific component and or diagnostic.
1	**02**	**06**	**04**		Injector Vacuum Supports Engineering	This section covers the cost of engineering, design, and the defense of earthquake and other safety reviews specifically for the supports of vacuum chambers and vacuum components.
1	**02**	**06**	**05**		Injector Vacuum Supports Components	All parts purchased and or fabricated for the of non specific vacuum supports
1	**02**	**07**			Injector Diagnostics	System Summary
1	**02**	**07**	**01**		Beam Position Monitors	System Summary
1	**02**	**07**	**01**	**01**	Large Aperture Injector BPM	Beam Position Monitors (BPM) identify the local position of the electron beam relative to a known mechanical and magnetic reference (quadrupole magnet magnetic center relative to physical references). The LCLS linac has two BPM design types; electrode and RF. The stripline electrode BPM generates a signal proportional to the dimensional offset between the electron bunch center and the BPM center. The RF BPM is an RF resonant cavity that measures the bunch position based on the amplitude and phase shift of the RF pulse proportional to the electron bunch. BPM and magnet data can be used to automatically tune the electron beam position. This device is a strip line electrode type BPM of proven design. Many examples of this design are installed in SLAC Linac Quadrupole magnets. This item specifically has a large beam aperture for use in the immediate region of the RF Gun..
1	**02**	**07**	**01**	**02**	Small Aperture Injector BPM	Beam Position Monitors (BPM) identify the local position of the electron beam relative to a known mechanical and magnetic reference (quadrupole magnet magnetic center relative to physical references). The LCLS linac has two BPM design types; electrode and RF. The stripline electrode BPM generates a signal proportional to the dimensional offset between the electron bunch center and the BPM center. The RF BPM is an RF resonant cavity that measures the bunch position based on the amplitude and phase shift of the RF pulse proportional to the electron bunch. BPM and magnet data can be used to automatically tune the electron beam position. This device is a strip line electrode type BPM of proven design. Many examples of this design are installed in SLAC Linac Quadrupole magnets. These units are for general Injector System use.
1	**02**	**07**	**02**		Current Monitors	System Summary
1	**02**	**07**	**02**	**01**	Current Monitors (Torroids)	Toroids measure both discrete local and integrated system level electron beam current. As a local device, a Toroid measures beam current by producing a signal proportional to the electron bunch current. Measurements by two or more Toroids in a system can be made to indicate average current per bunch. A system of Toroids can also be used to indicate beam losses by comparing bunch current at multiple locations. These torroids must be able to resolve the smallest amounts of charge, be UHV compatable, bakable to 200 C, and consume the least amount of beamline length.
1	**02**	**07**	**03**		Bunch Length Monitors	This device generates a signal proportional to the bunch length by measuring terahertz and synchrotron radiation produced as the electron beam passes through a thin foil.

WBS NUMBER					TITLE	DESCRIPTION
1	**2**	**3**	**4**	**5**		
1	**02**	**07**	**03**	**01**	Bunch Length Monitors	This device generates a signal proportional to the bunch length by measuring terahertz and synchrotron radiation produced as the electron beam passes through a thin foil.
1	**02**	**07**	**04**		Profile Monitors	Profile monitors are beam emittance and energy spread diagnostic devices. They characterize beam shape, size, and position. Profile monitor designs consist of a fluorescent screen or metal foil that interacts with the electron beam and produces secondary radiation that is monitored by detectors and/ or cameras.
1	**02**	**07**	**04**	**01**	Profile Monitors	Profile monitors are beam emittance and energy spread diagnostic devices. They characterize beam shape, size, and position. Profile monitor designs consist of a fluorescent screen or metal foil that interacts with the electron beam and produces secondary radiation that is monitored by detectors and/ or cameras.
1	**02**	**07**	**07**		PPS Stopper	The LTDL1 PPS Stopper is located between the two shield walls. This area also contains a wire scanner and OTR/YAG. The stopper protects people in the sector 20 alcove during normal LINAC operation when they service injector components in the gun and booster linac area behind the shield wall. This device will require air and actuation control electronics.
1	**02**	**17**			Injector Installation & Alignment	System Summary
1	**02**	**17**	**01**		Injector Infrastructure Installation	This section accounts for the general installation activities for the Injector tunnel at Sector 20. The activities are wide ranging and vary from, to alignment network and device footprints, to the installation completion of cable tray and other utilities. Post delivery operations like component alignment, pump down and leak check as well as all other operations that are necessary to bring the injector to 'commissioning' are included in this section for injector infrastructure.
1	**02**	**17**	**03**		Injector Lasers Install & Align	This section accounts for the specific tasks associated with the field installation of the specific Injector section. Specifically included; Laser Bay in the Control Room, Laser Transport to Injector Vault (penetration), and Laser Paths in the Injector Vault to the Heater and eventually into the Linac Housing.
1	**02**	**17**	**04**		Gun Area Integration	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**06**		Accelerator Area Integration	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**07**		Heater Area Integration	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**08**		Wall Area Integration	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**09**		Insertion Area Integration	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**11**		Spectrometer Area Integration	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**12**		Injector RF High Power System Install & Align	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**14**		Cathode and Load Lock Install & Align	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**15**		Injector Laser Heater Subsystem Install & Align	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
1	**02**	**17**	**17**		Power Conversion Subsystem Installation	This section accounts for the specific tasks associated with the field installation of the specific Injector section.
2	**02**				Injector System (OPC)	Other Project Costs (OPC) Summary for the Injector System. It includes effort and costs associated with R&D, Spares, and Commissioning.
2	**02**	**01**			Injector System Management & Integration	This element coves commissioning costs for this system.
2	**02**	**02**			Injector Controls Subsystem	System Summary
2	**02**	**02**	**01**		Personnel Protection System (PPS)	This element coves commissioning costs for this system.

WBS NUMBER					TITLE	DESCRIPTION
1	2	3	4	5		
2	02	02	04		Power Conv (Beamline pw supp) Spares	This element coves commissioning costs for this system.
2	02	03			Injector Lasers	System Summary
2	02	03	01		Drive Laser Prototyping	This element covers special processing spares required for this section.
2	02	03	02		Drive Laser System	This element covers special processing spares required for this section.
2	02	03	14		LSR HTR-Beam Conditioning Optics (Laser Bay)	This element covers special processing spares required for this section.
2	02	04			Injector RF Subsystem	System Summary
2	02	04	01		RF Gun and Load Lock	This element covers special processing spares required for this section.
2	02	04	01	01	RF Gun	This element covers special processing spares required for this section.
2	02	04	01	02	RF Gun Supports	This element covers special processing spares required for this section.
2	02	04	01	03	Gun Load Lock	This element covers special processing spares required for this section.
2	02	04	02		Cathode Processing (CP) Station	This element covers special processing spares required for this section.
2	02	04	02	02	CP Load Lock	This element covers special processing spares required for this section.
2	02	04	05		Injector RF Waveguide Subsystem	This element covers special processing spares required for this section.
2	02	04	05	02	RF Waveguide Supports	This element covers special processing spares required for this section.
2	02	04	06		Injector Linac Structures	This element covers special processing spares required for this section.
2	02	04	06	02	L0-2 Structure Assembly	This element covers special processing spares required for this section.
2	02	05			Injector Magnets & Supports	System Summary
2	02	05	02		Injector Quadrupoles	This element covers special processing spares required for this section.
2	02	05	02	03	DL1 QB Quadrupole	This element covers special processing spares required for this section.
2	02	05	02	05	SAB Quadrupoles ( )	This element covers special processing spares required for this section.
2	02	05	03		Injector Steering Coils	This element covers special processing spares required for this section.
2	02	05	03	04	DL1TL Steering Coils (X-Y Assys)	This element covers special processing spares required for this section.
2	02	07			Injector Diagnostics	System Summary
2	02	07	01		Injector Beam Position Monitors	This element covers special processing spares required for this section.
2	02	07	01	03	L0-1TL0-2 BPMs ( )	This element covers special processing spares required for this section.
2	02	07	01	04	LTDL1 BPMs ( )	This element covers special processing spares required for this section.
2	02	07	04		Injector Profile Monitors	This element covers special processing spares required for this section.
2	02	07	04	01	GTL Faraday Cup/YAG1	This element covers special processing spares required for this section.
2	02	17			Injector System Commissioning	System Summary
2	02	17	02		Drive Laser Commissioning	This element covers the effort associated commissioning with the specific Injector functional area.
2	02	17	03		RF Conditioning	This element covers the effort associated commissioning with the specific Injector functional area.

WBS NUMBER					TITLE	DESCRIPTION
1	**2**	**3**	**4**	**5**		
2	**02**	**17**	**04**		RF Gun Operation with Beam	This element covers the effort associated commissioning with the specific Injector functional area.
2	**02**	**17**	**05**		L0-1&L0-2 Commissioning	This element covers the effort associated commissioning with the specific Injector functional area.
2	**02**	**17**	**06**		L0&SAB Commissioning	This element covers the effort associated commissioning with the specific Injector functional area.
2	**02**	**17**	**07**		DL1 Commissioning	This element covers the effort associated commissioning with the specific Injector functional area.
2	**02**	**17**	**08**		Injector Optimization	This element covers the effort associated commissioning with the specific Injector functional area.