Project Requirements - Lvl 1- Project (Customer Reqs)

Section	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body	RQ Description (What is the RQ talking about?)	RQ Rationale (Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
Project Definition	--	PROJ-01	Project Scope	The project	Shall	Develop a hybrid engine	To compete in the 30,000 ft SRAD hybrid engine category	definition of rocket class, based on needs of RITLaunch	None					
Project Definition		PROJ-02	IREC Performance Requirements	The project	Shall	Develop an engine that meets all IREC performance and design requirements							Inspection	
Safety	TBR	PROJ-03	IREC Safety Requirements	The project	Shall	Adhere to all IREC safety requirements for the design and testing							Inspection	
		PROJ-04	IREC Testing	The project	Should	Perform all tests required and recommended by IREC	Tests include loading/off-loading tests, tank proof and burst tests, etc	Design required to be capable of doing this, so it will be easier to perform tests early on in design phase. However, if all are not completed, RIT Launch will be able to finish the tests in the year leading up to the competition					Demonstration	
Project Definition		PROJ-05	Rocket Mass	The project	Shall	Develop an engine capable of carrying a 120-150 lb (wet) rocket							Inspection	
Project Definition	TBR	PROJ-06	Altitude	The project	Shall	Reach an altitude of exactly 30,000 ft	Main project goal is to develop an engine to be used in Spaceport America competition, which requires propelling a rocket to exactly 30,000 ft. Mass includes engine pass						Analysis	
	TBD	PROJ-07	Redundancy	The project	Should	Implement single fault tolerance as often as possible	Work to single fault tolerance through design, will need to be analyzed individually for other impacts						Inspection	Need to look into IREC redundancy requirements
	TBD	PROJ-08	Reusability	The project	Shall	Develop an engine and test stand capable of being reused multiple times	Single engine must be able to be tested multiple times, and then launched. As such, the test stand must be able to be used multiple times with minimal refurbishment between tests						Demonstration	
Safety	--	PROJ-09	RIT Safety	The project	Shall	Follow all safety requirements set forth by RIT in the development and testing of the engine	Have firefighter on site during test fire(s)		None				Demonstration	Need to meet with RIT Risk and Safety to better understand
	TBR	PROJ-10	Budget	The project	Shall	Remain within the allocated project design budget			None				Inspection	
	TBR	PROJ-11	Static hot fire	The project	Shall	Include a full scale static hot fire for demonstration of the technology	Full test fire is defined as the engine operating at a full, constant thrust for at least 10 seconds						Demonstration	
	TBR	PROJ-12	Integration	The project	Shall	Be easily integrated into an 6" diameter rocket or test stand	Integration includes attaching the engine to the structure and connecting power lines						Demonstration	
		PROJ-13	Manual control	The project	Should	Develop a control system that allows users to manually control valves/actuators and shut off engine if needed							Demonstration	
		PROJ-14	Transportation	The project	Shall	Develop a safe and reliable way of transporting the engine that avoids damage to any of the components	Once built, the engine will need to be transported around campus to different facilities, and potentially to off-campus locations while not attached to the rocket. Since only 1 engine is being made, no damage can occur to any of the parts	Budget-costly to replace damaged parts, Reliability					Demonstration	
		PROJ-15	Electronic Communication	The engine	Shall	Be able to communicate with the rocket's avionics system through a wired connection							Demonstration	
	TBR	PROJ-16	Testing requirements	The project	Shall	Include a full test plan/procedure to verify the components of various subsystems and the engine as a whole	Test procedures should be able to be approved by RIT risk/safety prior to any hot fires							
		PROJ-17	Documentation	The project	Shall	Provide thorough documentation of the research, design, manufacturing, and testing of the rocket, as well as justification for the design decisions made								

Project Requirements - Lvl 2-Test Stand

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
	TBR		Structure	The test stand	Shall	be able to withstand the maximum amount of thrust expected from the rocket with a factor of safety of 2	The test stand needs to hold the rocket in place for both safety and usability	If the rocket overloads the test stand and blasts into the bunker it creates a safety hazard					FEA	
	--		Reusability	The test stand	Shall	be reusable so that the rocket engine could be fired again without any major modifications							Fire the rocket twice!	
	--		Electronics	The test stand	Shall	be able to record all desired measurements from the test firing of the rocket easily	The test stand should have an integrated sensor array so that the rocket can be fired and data can be recorded without custom setup each time	The test stand should more or less be a separate module from the rocket, although the rocket will need manually instrumented as well					Test recording data before firing the actual rocket	
			Liquid Offloading	The test assembly	Shall	be able to successfully (without any anomolies) load and offload the liquid propellent from the engine	In case of a test abort, there needs to be a way of off-loading the fluid from the engine in order to safe the area for humans to enter. This operation must be given electronically	Safety, IREC Requirement					Dry run	
			Fake Telemetry	The test stand	Shall	be able to connect to the rocket engine controller and provide information similar to what would be provided by the flight controller/avionics system	Data can be faked based on measurements, or even completely arbitrarily	Actual avionics data is difficult to get while stationary					Controller integration pre-firing	
			Force Measurement	The test stand	Shall	Record accurate force/thrust measurement from the rocket on the test stand								
	TBR		Heat	The test stand	Shall	Be able to withstand the maximum heat output from the rocket with a factor of safety of 2								
			Heat/Flame	The test stand & bunker	Shall	Not be constructed of or contain any materials that are highly flammable								
			Exhaust	The test stand & bunker	Shall	Be configured in a way that exhaust plumes/flame can be directed out of the bunker and away from people								
			Vibration	The test stand	Should	Record vibration of the rocket engine during testing		This adds information that can be used during rocket design						
			Thermocouples	The test stand	Shall	Measure rocket temperature with thermocouples in a few key locations								
	TBD		Pressure transducers	The test stand	Should	Measure pressures within the rocket chamber (& elsewhere?) if possible								
			IR Camera	The test stand	Should	Record the engine's plume temperatures with an infrared camera during the test fire								
			GoPro	The test stand	Shall	Monitor the rocket test with at least one camera feed that is both recorded and streamed to a location nearby	So that we can see what's going on with the rocket and also review footage if necessary	Why would we fire an engine if we couldn't see it?						
			Tank Pressure	The test stand	Shall	Monitor the pressure inside of the propellant tanks as seen by the engine controller	The sensors will be there and be used by the controller but it has to also be recorded							
					Shall									
					Shall									
Safety	TBR	PROJ-06	Material Safety	The test stand	Shall	Use only materials that can be stored, transported, and handled safely	Materials must be able to be handled without the need for extensive equiptment individually, and when assembled							
		PROJ-10	Budget	The test stand	Shall	Cost $2000 or less								

Project Requirements - Lvl 2-Engine

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
Perfomrance	TBR	ENG-01	Minimum Thrust	The engine	Shall	Have a maximum total thrust of 1150 lbf	Based off of IREC recommendation to achieve 100 ft/s by end	Defines performance metric of rocket	PROJ-05				Test	
		ENG-02	Engine Control	The engine	Should	Must undergo a rigorous internal ballistic analysis			PROJ-05				Test	
Preformance	TBR	ENG-03	Specific Impulse	The engine	Shall	Be capable of providing a specific impulse of 300 sec			PROJ-05				Test	
Preformance	TBR	ENG-04	Burn time	The engine	Shall	be capable of sustaining maximum thrust for 20 seconds			PROJ-05				Test	
Performance		ENG-05	Maximum Total Impulse	The engine	Shall	not exceed a total impulse of 9208 lbs-sec (40960 N-s)	Limit defined by FAA definition of Class 2 Amateur Rocket		PROJ-02				Demonstration	
		ENG-06	Fuels	The engine	Shall	use a hydrocarbon fuel grain			PROJ-03				Inspection	
		ENG-07	Factor of Safely - Composites	The engine	Shall	FoS of 3		IREC requirement	PROJ-03				Analysis	
		ENG-08	Factor of Safety - Metals	The engine	Shall	FoS of 2		IREC requirement	PROJ-03				Analysis	
	TBR	ENG-09	Reusablility	The engine	Shall	be able to be reused 5 times before being retired	5 times based off of 2 MSD hotfires, 1 Launch integration hotfire, 1 test launch, and 1 competition launch		PROJ-08				Demonstration	
	TBD	ENG-10	Throttling	The engine	Shall	be able to be throttled down to TBD % of full thrust			PROJ-06				Test	
		ENG-11	Integration	The engine	Shall	be able to easily integrate to a 6" diameter rocket.	Integration includes power lines, plumbing lines, structural attachments, thermal interaction, etc.		PROJ-12				Demonstration	
		ENG-12	Statics hot fire	The engine	Shall	be able to complete an instrumentated, full scale hot fire			PROJ-11				Test	
Safety		ENG-13	Ignition Safing	Ignittion devices	Shall	include a "safe" position to be used prior to final countdown to hot fire	Any energetics needs to be in a safe cconfiguration for transportation and loading where there is no possibilty of ignition. The energetics can then be "armed" once the engine is in its final countdown for launch. Safe is defined as needing two separate events to release any stored energies.	IREC Requirement, general safety for everyone	PROJ-14				Demonstration	
		ENG-14	Ignition Accessability	Ignittion devices	Shall	be externally controllable and easily accessible	This does not preclude the limited use of access panels which	IREC Requirement	PROJ-13				Demonstration	
		ENG-15	Propelleant Offloading	The engine	Shall	be capable of safely loading and off-loading fluid while in "launch-configuration"	As part of IREC, the propultion system must be able to do a loading/off-loading test. This test may be conducted using either actual propellant(s) or suitable proxy fluids.	IREC Requirement, testing of plumbing and propulsion system	PROJ-04				Test	
		ENG-16	Pressure Relief	The engine	Shall	include pressure relief devices, set to open at no greater than proof pressure			PROJ-13				Demonstration	
		ENG-17	Modularity	The engine	Should	be easy to dissassemble into its various components for alterations and component testing	This includes no permanent adhesives. Avionics hardware (sensors, controls, electrical components, wiring) must be organized and designed in a comprehensible manner that is easy to follow, and won't cause major problems when disassembling or assembly engine body.		PROJ-08				Demonstration	
		ENG-18	Total wet mass	The engine	Shall	have a total wet mass under 100 lbs	Mass of engine, tank, and fuel	early estimate	PROJ-05				Inspection	
	TBD	ENG-19	Total dry mass	The engine	Shall	have a total dry mass under 70 lbs	Mass of engine, tank, (no fuel)	early estimate	PROJ-05				Inspection	
Integration	TBR	ENG-20	Total diameter	The engine	Shall	have a total diameter no greater than 150 mm	The entire dynamic envelope of the engine must stay within a cylander of 150 mm		PROJ-12				Inspection	
		ENG-21	Internal power	The engine	Shall	operate independently on its own internal power			PROJ-12				Test	
	TBR	ENG-22	Delayed safe mode	The engine	Shall	be capable of being completely disconnected from the ground for 1 hour	The engine must be able to survive in a safe state for 1 hour without any power or plumbing lines connected to the vehicle	Drive how long battery must hold charge and how long pressure tanks must hold at pressure	PROJ-03				Test	
Integraion		ENG-23	Oxidizer tank	The engine	Shall	Include the attached oxidizer tank as part of the design			PROJ-12				Inspection	
Integration		ENG-24	Engine controller commands	The engine	Shall	be able to receive command signals from a flight computer			PROJ-12 PROJ-15				Demonstration	
Integration		ENG-25	Engine controller comm	The engine	Shall	be able to send engine telemtery to the main rocket computer			PROJ-12 PROJ-15				Demonstration	
Integration		ENG-26	Test computer	The engine	Shall	be able to interface with a test computer to simulate a flight computer during test fires			PROJ-11 PROJ-15				Test	
	TBR	ENG-27	Referbishment	The engine	Shall	be able to be able to be referbished within a day for use again	This includes minimizing the number of parts that are needed to be replaced between flights, as well as making the combustion chamber easily accessible to replace fuel grain		PROJ-08				Demonstration	
		ENG-28	Center of gravity	The engine	Shall	have a CoG directly centered on its thrust vector			PROJ-06				Inspection	

Project Requirements - Lvl 2-Engine

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
		ENG-29	Descent Survival	The engine	Shall	survive a controlled parachute descent/landing once the launch is complete			PROJ-08				Demonstration	
Integration		ENG-30	Physical Mounting	The engine	Shall	mount to an 6" diameter Rocket and transfer all thrust loads			PROJ-12				Demonstration	
Safety		ENG-31	Toxicity	The engine	Shall	Not use/produce any toxic chemicals	Toxic chemicals are defined as requiring breathing apparatus, special storage and transport infrastructure, extensive personal protective equipment, etc.	Requirement for Spaceport America Cup	PROJ-09 PROJ-03				Analysis	
Safety	TBR	ENG-32	Material Safety	The engine	Shall	Use only materials that can be stored, transported, and handled safely	Materials must be able to be handled without the need for extensive equiptment individually, and when assembled		PROJ-14				Inspection	
		ENG-33	Redundancy	The engine	Should	Be single fault tolerant for any plumbing and electronic failures	Work to single fault tolerance through design, will need to be analyzed indivually for other impacts		PROJ-07				Inspection	
		ENG-34	Budget	The engine	Shall	Cost $8000 or less			PROJ-10				Inspection	
		ENG-35	Manual Control	The engine	Shall	be capable of accepting indepepndent control commands for individual components/valves			PROJ-13				Test	

Project Requirements - Lvl 3-Structures

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
			Structure Mass	The structure subsystem	Shall	have a mass less than the structures and mechanisms mass allocated for within the MEL	Subsystem mass tracked in the equiptment list							
			Propulsion thrust survival	The structure subsystem	Shall	allow for continuous operation of the engine through propulsion induced static, dyanamic, and thermal loads								
	TBD		Tank/Combustion chamber interface	The structure subsystem	Shall	have enough strength as to connect the two primary masses of the hybrid system while protecting the plumbing between the two								
	TBD		Rocket mechanical interface	The structure subsystem	Should	be able to interface with the rocket body so that it can be disassembled by X number of people in Y minutes?	Required for ease of repair/assembly. This may be crucial on launch day?							
	TBR		Lift points	The structure subsystem	Should	not be prone to dammage if 2 people are carrying the rocket motor at each end	when transporting the rocket for test fires or launch, the engine structure should be able to support its own weight when supported at both ends							
	TBR		Tie-down points	The structure subsystem	Should	not be prone to dammage when tied down to a cart	the structure should be durable for transport and have designated areas where straps can be tightly fastened or wrapped around							
			Rocket mechanical interface	The structure subsystem	Shall	remain secured to the rocket body	secured, meaning that the rocket engine won't shift during large accelerations at liftoff							
			Mode shapes/fundamental frequencies	The structure subsystem?	Shall	have (check that) mode shapes/frequencies don't significantly interfere with vibe freqs from engine or aero loads								
			Proof testing	All pressure vessels	Shall	be able to be proof tested to 1.5x MEOP								
			Isentropic burst pressure	Isentropic pressure vessels	Shall	be designed to 2x MEOP	MEOP considered for all pre-launch, flight, and recovery operations. See sec 4.2 of Spaceport requirements	Spacecup requirement						
			Non-isentropic burst pressure	Non-isentropic pressure vessels and COPVs	Shall	be designed to 3x MEOP	MEOP considered for all pre-launch, flight, and recovery operations. See sec 4.2 of Spaceport requirements	IREC requirement						
			Eye bolt saftey	Eye bolts	Should	be steel, closed-eye forged type.	NOT of the open eye, bent wire type.	IREC requirement						
			PVC Limitation	The engine structure	Shall	not use PVC in any load bearing case	Most notably the thrust chamber							
	TBR		Engine thrust angle-static	The engine structure	Shall	keep the engine thrust angle within .5 deg during static mounting								
	TBR		Engine thrust angle-dynamic	The engine structure	Shall	hold the engine thrust vector constant within 0.5 deg during fire								
			Tank mounting	The engine structure	Shall	provide a mounting interface to mount the tank onto the inside of the rocket								
			Electronics Mounting	The engine structure	Shall	provide mounting for the power distribution and control system	Mounting needs to isolate the systems from thermal and dynamic loads from the propulsion system							
			Sensor Mounting	The engine structure	Shall	provide mounting for all control sensors								
			Material Selection	The engine structure	Shall	Not use any materials that might react with either of the propulsion chemicals	Any of the structural components should not be able to break down chemically when coming in contact with the oxidizer and/or fuel at any temperature							

Project Requirements - Lvl 3-Propulsion

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
			Dry Mass	The Propulsion subsystem	Shall	have a dry mass less than allocated in the MEL								
			Wet Mass	The Propulsion subsystem	Shall	have a wet mass less than allocated in the MEL								
	TBD													
			Pressure relief	Pressure vessels	Shall	implement a relief device, set to open at no greater than the prroof pressure		Safety, Spaceport req						
			Controlled Ventig	Proplsion system	Shall	have remote controlled venting capabilities to unload all propellent	System needs to be able to offload all propellents in the case of an abort							
			Thrust level variation	The Propulsion subsystem	Shall	provide +/- TBD % thrust level variation under steady-state operations	At thruster level we will need a rise-time requirement too (performance characteristic).							
			Thrust level rise time											
			Pressurant	The propulsion subsystem	Shall	use TBD as a pressurant								
			Fuel	The propulsion subsystem	Shall	use TBD as fuel								
			Oxidizer	The proplsion system	Shall	use TBD as its oxidizer								
			Lubricants	The Propulsion subsystem	Shall	use only lubricants compatible with the propellants they may be exposed to.								
			Compatibility With Test Fluids	The Propulsion subsystem	Shall	for all potentially wetted materials, parts, seals, lubricants, etc., be compatible with prolonged exposure to the following test fluids: TBD								
				The Propulsion subsystem	Shall	Have pressure tanks that bleed on descent								
			Nozzle Performance											
			Fuel Grain Design	The fuel grain	Should	Be designed to allow for the most even burn rate through the entire grain								
			Fuel Grain Removal	The fuel grain	Shall	Be easily accessible and easy to remove before or after a hot fire								
			Telemetry Data	The Propulsion subsystem	Shall	Provide pressure and temperature telemetry data to the engine controller and flight computer								
			Pressure loss	The Propulsion subsystem	Should	Have a pressure loss less than TBD psi from the tank to the injector plate								
			Injector plate											
	TBR		Pressurization	The Propulsion subsystem	Shall	Be able to maintain a tank pressure of 750 psi from the end of prop load throught the end of launch								
			Pressurant											
			Fuel											
			Oxidizer											
			Dynamic Loads											
			Thermal Loads											
			Compatability with Test Fluids											
			Material interaction with proopellants											
			Nozzle Allignment											
			Thrust Direction											
			Accessibility											
			Operation Power Draw											
			Safed Power Draw											
			OPerating Temperature Range											

Project Requirements - Lvl 3-Thermal

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
			Thermal limits	The TC system	Shall	keep all electronics and valves within their thermal operating limtis	Thermal operating limits are specified within the ThEL							
			TCS Mass	The TC system	Shall	be less than the mass designated in the MEL								
			Passive control	The TC system	Shall	rely fully on a passive design	The system must use no powered devices and instead relay on passive design such as natural conduction/convection and ablative cooling							
			Structural protection	The TC system	Shall	Protect the structure of the engine from reaching .3*Tm during the duraction of the fire	Basing structural temperature limits off of melting temperature, need to avoid loss in mechanical strength from heating							

Project Requirements - Lvl 3-Controls

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
		CONT-01												
		CONT-02	Microcontroller	Controls Subsystem	Shall	Have a programmable microcontroller to control all electrical systems.								
		CONT-03	Low Power	Controls Subsystem	Shall	use low power digital devices.								
		CONT-04	Low Power Mode	Controls Subsystem	Should	be able to enter low power mode when applicable.								
		CONT-05	I/O	Controls Subsystem	Shall	have sufficient I/O for all peripherals (sensors, valves, power systems, etc.)								
		CONT-06	Clock Speed	Controls Subsystem	Shall	have a sufficiently fast clock speed and instruction speed to update the rocket as fast as possible, minimum 10MHz ideal 100MHz.								
		CONT-07	Code	Controls Subsystem	Shall	Have well-documented programming with modular functions.								
		CONT-08	Communication	Controls Subsystem	Shall	Communicate with a flight computer via TBD, which dictates all actions taken by the engine controller.								
		CONT-09	Modularity	Controls Subsystem	Shall	use modular/easily replaceable components (such as purchasable PCBs or wiring) where available.								
		CONT-10	Efficient PCB	Controls Subsystem	Should	Implement custom PCBs or wiring where it best saves space or diverts heat.								
		CONT-11	Start-up/Shutdown	Controls Subsystem	Shall	be able to start-up and shutdown the system.								
		CONT-12	Physical Start-up/Shutdown	Controls Subsystem	Shall	have a physical component (such as a switch) that needs to be activated before the system can start.								
		CONT-13	Emergency Shutdown	Controls Subsystem	Should	maintain an active high signal with the flight computer that designates a conditional emergency shutdown.								
		CONT-14	Sensor Data	Controls Subsystem	Shall	monitor and store sensor data.								
		CONT-15	Valve control	Controls Subsystem	Shall	throttle/control valves, where applicable.								
		CONT-16	Sense lines	Controls Subsystem	Should	have sense lines on sensitive components.								
		CONT-17	ADCs	Controls Subsystem	Shall	have at least one ADC for measuring sensors.								
		CONT-18	ADC bits	Controls Subsystem	Shall	have an ADC capable of measuring at least 10 bits of resolution for the sensors.								
		CONT-19	Communication Speed	Controls Subsystem	Shall	communicate at at least 10 Mbps per RS422 standards.								
		CONT-20	Duplex	Controls Subsystem	Shall	have minimum half-duplex (2 way non-simaltaneous) communication.								

Project Requirements - Lvl 3-Power

SECTION	Status	ID	RQ. Title	RQ. Subject	Priority	RQ Body or Section	RQ Description (i.e. What is the RQ talking about?)	RQ Rationale (i.e. Why is the RQ needed?)	Parent RQs	Children Sections	Children RQs	Impacts / Effects	Verification Method	Working Comments
		POW-01	PD Mass	The PD subsystem	Shall	be less than the mass allocated in the MEL								
		POW-02	On board power	The PD subsystem	shall	Supply all power needed to operate the engine independent of the rocket itself via a 12V, 100mAH minimum battery								
		POW-03	Valve Bus/Busses	The PD subsystem	Shall	Supply sufficient, constant power to every valve as required								
		POW-04	Sensor Bus/Busses	The PD subsystem	Shall	Supply sufficient, constant power to every sensor as required								
		POW-05	Autonomous shutoff	The PD subsystem	Should	Reserve sufficient power for an autonomous engine shut off if needed								
		POW-06	Power Protection	The PD subsystem	Shall	provide over-voltage and reversed current protection for the valves and sensors								
		POW-07	Rocket Integration	The PD subsystem	Shall	interface with the rocket power system through a single power line								
		POW-08	Max voltage draw	The PD subsystem	Shall	have a maximum value of 24V on any one component.								
		POW-09	Sensor power monitoring	The PD subsystem	Shall	Monitor the on-board voltage and current of GNC sensors, collectively.								
		POW-10	Battery Charge Margin for Launch	The PD subsystem	Shall	be capable of launch with a battery charge between 100% and 90%								
		POW-11	Battery Voltage Monitor	The PD subsystem	Shall	Monitor the on-board battery voltage								
		POW-12	Battery Current Monitor	The PD subsystem	Shall	Monitor the on-board battery current								
		POW-13	Battery Temperature Monitor	The PD subsystem	Should	Monitor the on-board battery temperatures								
		POW-14	Heat Dispersion	The PD subsystem	Shall	disperse heat throughout the system evenly / optimally without transfering heat to sensitive systems.								
		POW-15	Engine Autonomy	The PD subsystem	Shall	provide sufficient telemetry to the flight computer and power management flight computer to allow detection and correction of critical fault conditions without ground commands.								
		POW-16	Holding Charge	The PD subsystem	Shall	Be able to hold its enough charge needed for flight for at least 60 minutes between charging and launch								
		POW-17	Low-Power Mode	The PD subsystem	Should	Be able to enter low-power mode while waiting for a start-up signal								
		POW-18	Battery Access	The PD subsystem	Shall	Include easy access to charge the battery even when integrated onto the rocket								
		POW-19	Battery Safety	The PD subsystem	Shall	use batteries with safety features like puncture protection.								
		POW-20	Overcharge Protection	The PD subsystem	Shall	Provide with batery overcharge protection								
		POW-21	Wiring	The engine	Shall	be no smaller than 22 AWG except where required by off-the-shelf components, per IREC requirements.								
		POW-22	Battery Discharge Current	The engine	Shall	have a minimum discharge rate of 1C.								
		POW-23	Batter Charge Current	The engine	shall	charge at a minimum rate of 0.005C								