A-TRIKE
Coordination Meeting
19 January 2004

Steps	DRIVER & DRIVES	CONTROLLER / DISPATCHER	BATTERY / REGENERATIVE BRAKE SYSTEM	VFI & POWER	REMARKS
1000	START SWITCH ON				
10	Activate Power Relay				This is activated by a "momentary-contact" on the start switch to activate a "latching relay"
20		Boot Computer			Automatically done with the availability of power
30		Check Battery Status – if low charge, send instructions for DRIVER to start engine manually			NEVER start VFI when the batteries do not have enough charge, as this will ruin the batteries
40	DRIVER: Start engine manually				External intervention of the driver

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50		Check Brakes, Accelerator & Clutch			These are "status" checks so that malfunctions are discovered and logged
2000	MANUALLY START ENGINE				
10	DRIVER: Accelerator at MEDIUM				This follows the conventional manual routine undertaken by drivers
20		Set desired frequency			Frequency is set but NOT yet implemented
30	DRIVER: Disengage clutch				This follows the conventional manual routine undertaken by drivers
40		Set voltage to minimum			Voltage is set but NOT yet implemented
50	DRIVER: Engage foot brake				This follows the conventional manual routine undertaken by drivers
3000	POST START-UP / PREPARATION FOR MOVING				

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10	DRIVER: Accelerator low				This follows the conventional manual routine undertaken by drivers
20		Send desired frequency			Controller/Dispatcher translates driver accelerator commands to frequency
30				Develop desired frequency	A control voltage is translated into frequency
40	DRIVER: Clutch still disengaged				This follows the conventional manual routine undertaken by drivers
50		Confirm voltage and frequency settings			The vehicle is ready to GO at this point in the START-UP PROCESS
4000	GO				
10	DRIVER: Manually combines the right mix of clutch and accelerator				This follows the conventional manual routine undertaken by drivers

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20		Get voltage and frequency commands --- If V is at max. and frequency is relatively low… --- Bring down voltage and keep f steady, such that VFI is NEVER driven --- For rev-up, increase Voltage			VFI is for driving traction (acceleration) and NOT for deceleration. Deceleration is for the REGENERATIVE braking function
30		Send CALCULATED frequency value			The driver's accelerator control is translated into frequency
40				Frequency to desired level	Desired value
50		Send CALCULATED voltage value			The driver's accelerator control is also translated into voltage
60				Voltage to desired level	Desired value
5000	DECELERATE FROM STEADY-STATE(electric prime-mover system only)				

Steps	DRIVER & DRIVES	CONTROLLER / DISPATCHER	BATTERY / REGENERATIVE BRAKE SYSTEM	VFI & POWER	REMARKS
10	DRIVER: Reduce accelerator				The driver wants to decelerate
20		Reduce VOLTAGE Maintain FREQUENCY			The VFI must NEVER be driven by the wheel
30				Develop desired voltage	Reducing the voltage will reduce the current that will reduce the magnetic coupling between the stator and the rotor so that the wheel does not feed back power to the VFI
40		Activate CHARGER --- VFI Voltage should be at minimum			REGENERATIVE braking. The VFI must be de-activated if the charger should be activated
50			Charging is CARRIED OUT at predetermined voltage and current levels & according to pre-programmed hardware values		Charger system is provided with its own protective system so that it always takes care of itself
6000	STOP FROM MOVING AT STEADY-STAGE (electric prime-mover system only)				

Steps	DRIVER & DRIVES	CONTROLLER / DISPATCHER	BATTERY / REGENERATIVE BRAKE SYSTEM	VFI & POWER	REMARKS
10	DRIVER: - Brakes at max OR - Clutch disengaged for coasting				Either of the conditions will trigger the controller/dispatcher response
20		Set Voltage to minimum --- Ignore accelerator			Accelerator and brakes are mutually exclusive-- BRAKES HAVE PRIORITY!!!
30				Develop minimum voltage	Implement command
40		Activate charger			REGENERATIVE braking
50			Charging is CARRIED OUT at predetermined voltage and current levels & according to pre-programmed hardware values		Charger system is provided with its own protective system so that it always takes care of itself
7000	POWER REQUIREMENT BEYOND CAPACITY OF VFI				

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10	DRIVER: Accelerator demand GOING higher				The vehicle is about to require more power than the VFI can provide
20		Check if it will be BEYOND VFI capacity --- If YES --- send signal to engage throttle --- Calibrate this value so that opening is a little higher than required AND			Calibration of the reaction of the throttle and the force to manipulate it is required
30	---> Engage throttle by providing throttle drive				The "--->" sign indicates the reaction of the mechanical and electrical drives of the vehicle A DC motor provides the required force
40		--- send signal activate engine clutch to rotate engine shaft			The engine is started by rotating its shaft from the wheel shaft

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50	---> Activate solenoid for engine clutch				An electrically driven "actuator" is used because it is already available
60	---> Engine runs				Engine is being driven by the wheel Its speed must be increased relatively fast so that it becomes the prime-mover
70		Check TORQUE --- Immediately open throttle for a POSITIVE TRACTION torque --- Vehicle will experience a spurt of speed here			The Controller/Dispatcher determines the engine speed
80	DRIVER: Manually manipulates accelerator				The driver provides the necessary feedback signal
90		Track driver's commands and adjust accelerator as required			Controller/Dispatcher tracks driver's commands

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100		Check current of VFI --- If current decreases, --- Reduce voltage to MINIMUM --- DO NOT reduce frequency			The VFI current will decrease as the engine picks up load
110		Send VOLTAGE command to VFI			Appropriate command
120				Develop desired voltage	Implement command
130		Check engine power If less than desired dispatch power --- Engage charger to absorb extra power from engine			Evaluate if the engine is now loaded to its most efficient operating level. If not sufficient, activate the charger to become its load
140		Send Charger command			Send command
150			Charging is CARRIED OUT at predetermined voltage and current levels & according to pre-programmed hardware values		Implement command

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8000	DECELERATE FROM STEADY-STATE MOVEMENT (gas system is the prime-mover)				
10	DRIVER: Does the following: --- Decrease accelerator OR --- engage brakes OR --- disengage clutch OR --- any combination of the three				Modes of deceleration
20		Check desired deceleration			Deceleration is specified by the driver commands
30		Reduce Throttle			Decision made by the Controller/Dispatcher
40	---> Implement throttle command				Implement command
50		Engage Regenerative Braking System			Recover the kinetic (or potential) energy and store in batteries

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60			Charging is CARRIED OUT at predetermined voltage and current levels & according to pre-programmed hardware values		Implement command
70		Send lower throttle setting			Reduce engine load
80	---> Implement lower setting				Implement command
90		Check if within range of VFI --- If within --- Set frequency --- Set voltage			As the system decelerates, the engine load will decrease and the power requirements will fall within the capacity of the VFI
100		Send frequency command			Activate frequency first so that there is no way that the VFI is “driven” by the shaft
110				Implement frequency command	Implement command

Steps	DRIVER & DRIVES	CONTROLLER / DISPATCHER	BATTERY / REGENERATIVE BRAKE SYSTEM	VFI & POWER	REMARKS
120		Send voltage command			Engage the “magnetic coupling” by increasing the voltage so that current would be sent to the motor
130				Implement voltage command	Implement command
140		Check TORQUE of ENGINE --- If almost ZERO, disengage engine clutch			Low engine torque indicates that the VFI has taken over and that engine is not needed anymore
150	---> Disengage engine clutch				Implement command
160		--- DO NOT stop engine yet. Wait XX seconds and shut off engine			A lull of a few seconds is provided so that the engine is available again, if needed
170	---> Shut off engine				Implement command
9000	SWITCH OFF				
10	DRIVER: Decides to switch-off				Driver's final decision is required
20		Wait YY seconds and shut down power			A lull of a few seconds is provided to stabilize electronic circuits

Steps	DRIVER & DRIVES	CONTROLLER / DISPATCHER	BATTERY / REGENERATIVE BRAKE SYSTEM	VFI & POWER	REMARKS
30	Shut down Power Relay				The OFF contact is activated