SOLAR PHOTOVOLTAIC ARRAY TEST PROCEDURE

1. DEVICE NAMING COORDINATION

1.1. The System Integrator shall coordinate with the TMC/ROC to identify the device names for each device.

1.2. The System Integrator shall then send a request to TOTS to identify the network name, IP address, and any pertinent configuration information.

2. EXPLANATION – STANDALONE (SALT) TESTING

2.1. The System Integrator shall work with the DEVICE VENDOR (if required by the testing form) and complete the NDOT specified SALT tests (non-network) on each unit of equipment after installation.

2.2. Conduct SALT testing on each unit of equipment as outlined on the NDOT provided testing form.

2.3. The System Integrator shall coordinate through the Resident Engineer and the Construction Crew to have an appropriate NDOT representative present for the onsite inspection.

2.4. The System Integrator shall submit the DEVICE vendor commissioning documents, if applicable, with the SALT testing to the Engineer for review and approval.

2.5. Supply a bucket truck and operator, or suitable equivalent equipment necessary to carry out procedures as required by the testing documents, at no direct payment.

SOLAR PHOTOVOLTAIC ARRAY (SPV Array) SALT PROCEDURE

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL

SPV Array Name:		**IP Address:**		**GPS:**	
TOTS Network Name:		**Associated Cabinet Name:**			

Purpose and General Verification

System Integrator: *This SALT tests the proper installation of a functional SPV Array. The system integrator shall use a laptop to perform this test. Using the manufacture's software, the integrator shall be able to verify the SPV Array is operational.*

General Verification*: For each test below, complete the SPV Array SALT Matrix, circling the "Pass" or "Fail" in the appropriate cell. Only indicate a "Pass" on this form if the entire matrix column related to the tested function passes for EACH SPV Array being tested.*

SPV ARRAY Information

1.	Verify SPV Array information using the manufacturer software or device label. If additional rows are required for recording, refer to the Ancillary Equipment Information sheet at the end of the SALT procedure.	**Photovoltaic Modules** **Manufacturer: _____** **Model: _____** **Serial Number: _____** **Manufacture Date: _____**	Were additional sheets needed? Yes / No
2.	Verify SPV Array information using the manufacturer software or device label. If additional rows are required for recording, refer to the Ancillary Equipment Information sheet at the end of the SALT procedure.	**Batteries** **Manufacturer: _____** **Model: _____** **Serial Number: _____** **Manufacture Date: _____**	Were additional sheets needed? Yes / No
3.	Verify SPV Array information using the manufacturer software or device label.	**Solar Charge Controller** **Manufacturer: _____** **Model: _____** **Serial Number: _____** **Manufacture Date: _____**	Pass / Fail
4.	If applicable, verify SPV Array information using the manufacturer software or device label. If additional rows are required for recording, refer to the Ancillary Equipment Information List sheet at the end of the SALT procedure.	**DC-DC Converter** **Manufacturer: _____** **Model: _____** **Serial Number: _____** **Manufacture Date: _____**	Were additional sheets needed? Yes / No / N/A
5.	If applicable, verify SPV Array information using the manufacturer software or device label. If additional rows are required for recording, refer to the Ancillary Equipment Information List sheet at the end of the SALT procedure.	**DC-AC Inverter** **Manufacturer: _____** **Model: _____** **Serial Number: _____** **Manufacture Date: _____**	Were additional sheets needed? Yes / No / N/A

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
6.	Commissioning of SPV Array equipment.	Confirmation of full operation of all SPV Array -associated equipment.	Pass / Fail
Equipment Verification			
7.	Verify SPV Array solar charge controller is securely mounted in cabinet.	SPV Array solar charge controller is securely mounted in cabinet.	Pass / Fail
8.	Verify solar array is securely mounted on standard.	Solar array is securely mounted on standard.	Pass / Fail
9.	Verify ancillary SPV Array equipment is securely mounted in cabinet.	Ancillary SPV Array equipment is securely mounted in cabinet.	Pass / Fail
10.	Verify cables are labeled and neatly managed throughout the cabinet.	Cables are labeled and neatly managed.	Pass / Fail
11.	Using a meter, verify the system is properly bonded to earth ground.	Meter reading of 5 Ohms or less.	Pass / Fail
12.	Verify SPV Array operations locally via charge controller.	SPV Array powers the load equipment system.	Pass / Fail
13.	Verify SPV Array solar charge controller is configured to the appropriate battery type.	SPV Array solar charge controller is configured to the appropriate battery type (AGM or lithium-ion).	Pass / Fail
14.	Verify SPV Array solar charge controller is configured to the appropriate charge capacity.	The charge capacity is at an appropriate amperage based on the manufacturer's battery data sheet.	Pass / Fail
15.	Verify SPV Array alignment.	Alignment has a southern orientation with a tilt equal to the array's site latitude plus 15°, or as directed by the Engineer. No shadows fall upon the solar modules. Confirmed by Resident Engineer.	Pass / Fail
16.	If connecting to other devices, verify DC-DC conversion with a multimeter.	Incoming-outgoing voltage values falls within the specified load equipment power requirements determined by the device manufacturer. **Incoming voltage: _____** **Outgoing voltage: _____**	Pass / Fail / N/A
17.	If connecting to other devices, verify DC-AC inversion with a multimeter.	Incoming-outgoing voltage values falls with the specified load equipment power requirements determined by the device manufacturer. **Incoming voltage: _____** **Outgoing voltage: _____**	Pass / Fail / N/A

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
18.	Verify battery array functionality.	Incoming-outgoing voltage falls within manufacturer's recommendations. **Incoming voltage: _____** **Outgoing voltage: _____**	Pass / Fail
19.	Verify SPV Array functionality on both sides of the charge controller.	Incoming-outgoing voltage falls within manufacturer's recommendations. **Incoming voltage: _____** **Outgoing voltage: _____**	Pass / Fail
20.	Verify all bolts and screws are torqued to manufacturer's recommendations.	All bolts and screws are torqued to manufacturer's recommendations.	Pass / Fail

Signatures

DATE	**AGENCY/FIRM**	**PERFORMED BY** (Print Name) (Integrator)	**INTL**	**AGENCY/FIRM**	**WITNESSED BY** (Print Name) (NDOT)	**INTL**

Integrator Signature	
NDOT Signature	

Solar Photovoltaic Array (SPV Array) Ancillary Equipment Information List

If additional sheets are required for recording the ancillary equipment for a Solar Photovoltaic Array, print and number the sheets in numerical order in the space provided above and staple/paperclip as a packet.
If fields are identical, it is acceptable to indicate as such:

EXAMPLE ONLY – Information in this table is purely fictitious and may not accurately represent real information found on the device label				
Equipment Type	**Manufacturer**	**Model**	**Manufacture Date (MM/DD/YYYY)**	**Serial Number**
Battery	Battery Manufacturer 1	Battery Model 1A	01/01/2050	FG812678G
“ “	“ “	Battery Model 1B	01/05/2050	FH812854U
“ “	Battery Manufacturer 2	Battery Model 2D	01/05/2051	EB493248J
Photovoltaic Module	Solar Company	Module Model 1SOL	06/21/2040	SOL45892454966564
Solar Charge Controller	Charge Controller Company	Controller Model COM8430	“ “	COM456495541

SP Supply Name:		**IP Address:**		**GPS:**	
TOTS Network Name:		**Associated Cabinet Name:**			

Equipment Type	**Manufacturer**	**Model**	**Manufacture Date (MM/DD/YYYY)**	**Serial Number**

Cabinet Name: _____ **Page __ Of __**

3. EXPLANATION - SUBSYSTEM (SST) TESTING

3.1. At the beginning of the SST phase, the System Integrator shall submit, in PDF format and original signed hard copies of the certified SALT results for approval by the Engineer.

3.2. The Engineer shall approve all SALT testing prior to the System Integrator starting the SST testing.

3.3. Conduct SST testing in accordance with NDOT's testing documentation for all field and related equipment once the system has been interconnected to form a complete subsystem (i.e. Network connectivity).

3.4. The SST test shall demonstrate connectivity to all field equipment utilizing NDOT's current freeway management system (FMS).

3.5. The SST test consists of a 45-day period of operations without major failure of equipment. The Resident Engineer can require the SST be restarted if any major failure occurs. A major failure for the Solar Photovoltaic Array is defined as:

3.5.1. Any failure of the equipment associated with the PRIMARY FUNCTION of the Solar Photovoltaic Array.

3.6. Demonstrate that the total system (hardware, firmware, software, materials, and construction) are properly installed, free from problems, exhibits stable and reliable performance, and meets project requirements.

3.7. Once per week, the System Integrator shall demonstrate that all system functions tested in the SST are operational and meets requirements.

3.8. The System Integrator shall coordinate through the Resident Engineer and the Construction Crew to have an appropriate NDOT representative present for the onsite inspection.

3.9. The System Integrator must provide proof that each device has been tested each week for the duration of the testing period witnessed by an NDOT representative.

3.10. The testing time must be scheduled a minimum of one week prior and coordinated and approved by the Resident Engineer and the Construction Crew.

SOLAR PHOTOVOLTAIC ARRAY (SPV Array) SST PROCEDURE

TEST #	SST TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL

SPV Array:		**IP Address:**		**GPS:**	
TOTS Network Name:		**Associated Cabinet Name:**			

Purpose and General Verification

System Integrator: *This SST tests the proper installation of a functional SPV Array. The system integrator shall use an Operator Workstation at the TMC/ROC to perform this test.*

General Verification*: For each test below, complete the SPV Array SST Matrix, circling the "Pass" or "Fail" in the appropriate cell. Only indicate a "Pass" on this form if the entire matrix column related to the tested function passes for EACH SPV ARRAY being tested.*

System SPV ARRAY Information

1.	Verify network connectivity by issuing a ping test from the SPV Array workstation located at the TMC/ROC.	SPV Array responds to the ping test.	Pass / Fail / N/A
2.	Verify field device operation with system turned on from the SPV Array workstation located at the TMC/ROC.	Visual confirmation of field device activation.	Pass / Fail / N/A
3.	Verify field device operation with system turned off from the SPV Array workstation located at the TMC/ROC.	Visual confirmation of field device deactivation.	Pass / Fail / N/A
4.	Verify data values from SPV Array are being transmitted to TMC/ROC.	SPV Array data received at TMC/ROC.	Pass / Fail / N/A
5.	Verify accuracy of data values from SPV Array.	SPV Array data received at TMC/ROC matches values received from SALT procedure.	Pass / Fail / N/A

Signatures

SST DAY	DATE	PERFORMED BY (Print Name) (Integrator)	INTL	WITNESSED BY (Print Name) (NDOT)	INTL
1					
8					
15					
22					
29					
36					

45					
Integrator Signature					
NDOT Signature					