Fault Category	Underlying cause(s) & consequences
Modules	
Light-Induced Degradation	Yellowing, browning & delamination above cells and their interconnections, bubbles inside module, cracks in solar cells, & anti-reflective defects combine to increase series resistance and thus heating &/or 'Hot Spots'
Line-to-Line Interconnections (Intra- & Inter- Series)	Can occur at various positions between and within different modules mounted on the same of different racking (mounting) assemblies
Intra-panel solar cell interconnections	Caused by corrosion, 'Snail-Trail' contamination, 'Hot-Spots', broken interconnectors, cracks & burn marks
Delamination & Internal Corrosion	When delamination occurs moisture is likely to enter a module giving rise to corrosion at the level of busbar, tab wires and finger connectors, giving rise to safety issues (current leachage), heating & fire
Backsheet Failure (Outer Layer - air side)	Cracking, delamination & yellowing. Moisture enters & provokes corrosion, 'Hot Spots', 'Snail Trails' and tell-tale burn marks which in turn cause short circuits & inverter tripping & PV array shut-down due to advanced faults
Backsheet Failure (Multiple Inner Layers - cell side)	Cracking propagates through polyester core. In turn, these cracks can cause delayed inverter starts, ground faults & fires.
Micro-fissures	During transport & installation glass panels are subjected to various stresses that induce the formation of micro-fissures. Sunsequent moisture infiltration can give rise to 'Hot-Spots', 'Snail-Trail' contamination & panel failure
Bypass Diode Fault	Malfunction over time or poor installation
Module disorientation	Power production losses at outset due to poor installation & later due to racking failure, substrate settlement of varying degrees. Latter is a major issue for solar covered landfill
Arc faults	Formation of discontuity between current-carrying conductors caused by solder disjoint, insulation breakdown / aging, solar cell damage, rodent damage &/or abrasion
Complete panel failure	Aging, poor design, or poor manufacture, defective solar cells, glass defects, or inconsistentcies in Bill of Materials
Upper & Lower Ground Fault	Can occur with zero fault impedance to ground (Earth) originating between the last two modules within a String Series (Upper) or between the second and third

	last modules in a String Series (Lower), latter linked to large backflow current
Open Circuit Fault	Break in panel to panel joints or cables; objects falling on panel(s); loose cable terminations to Junction Box on rear-side of solar panel, hail
Shading, Soiling and Snow	Partial or total shading due to trees, buildings, power poles, clouds, heavy rain, dust, mould, pollen, stains, foam, bird droppings, snow, & hail, can impair function within and across one or more String Series.
Short-circuit Current Mismatch of solar cells or modules	Mismatch losses are caused by the interconnection of solar cells or modules which possess dissimilar properties or which experience different conditions from one another. Short-circuit current across two or more cells must be the same, thus overall current from the combination cannot exceed that of the poorest cell or module. At low voltages, the extra current-generating capability of healthy cells or modules is not dissipated but instead is dissipated as heat in the poor cell or module. Mismatches occur in all arrays at all times & result in available DC power being below predicted levels.
Degradation of encapsulant ethylene vinyl acetate (EVA) copolymer	Can cause loss of PV module performance due to a combination of photodegradation, moisture, delamination, bubble formation and potential induced degradation (PID) or PID (shunt type) due to large numbers of local shunts between front glass and solar cells.
Structural failures	module breakage or frame deformation due to excessive, wind load, snow load, panel glass too thin, racking poorly mounted, incorrect placement of module attachments to racking.
Potential-Induced Degradation(PID)	Caused by harmful leakage of 'stray currents'; can result in significant power loss; occurs mostly at negative voltage with respect to ground; & is accelerated by high temperatures, humidity levels & system voltages.
Shattering of glass panel	Can be provoked by 'Hot Spots' , impact of falling objects, hails &/or stresses introduced between racking system and solar panel frame due to racking system instability / poor installation thereof. Cracks usually start next to panel frame and propagate further
Humidity in Junction box (back of module)	Can cause inverter tripping
Aging	Solar irradiation conversion efficiency is decreased over time & more so during Year 1. The likelihood of total panel failure and other faults is also increased with age.
Theft & Vandalism	Can be a serious problem in different parts of the world

Wiring / Cabling Defects between panels & Central Inverter	
Abrasions	Moisture infiltration can result from abrasions intra-panel & inter- panel cabling. This is caused & exacerbated by wind &/or loose racking attachments.
Animals knawing at cables, building nests, etc.	Solar panel installations placed in the field provide ideal shelter for a variety of wildlife. This co-existence can cause degradation of particularly interconnecting cables.
Lightning	Lightning can cause considerable damage to PV arrays and failure of central inverter components. It is a relatively common occurrence.
Inter-Series Combiner Box Malfunction	Inter-series Combiner Box malfunction can be due to aging, animal interference, corrosion, or loose cable terminations at outset (poor workmanship) or those that develop over time
Blown Fuses	Current surges can cause fuses to "blow / break" & thus must be replaced when & where required
Central Inverter	
Unidirectional Insulated-Gate Bipolar Transistor (IGBT) failure	Wear & tear can cause these three-terminal floating-gate MOSFET semiconductors to fail completely
Inverter tripping	Due to the presence of advanced or uncleared electrical faults within PV array
Shutdown due to overheating	Maximum operating temperature is surpassed. Therefore, a need to improve ventilation &/or cooling systems; clean dust filters; &/or clear surrounding undergrowth
Isolation Ground Fault in DC section	Most frequently due to moisture entering damaged cabling sleeve, faulty installation, poor connection of the DC cables to the panel, or moisture in the Junction Box of PV module. These system errors can leed to the presence of potentially fatal voltages.
Failure to restart after a grid fault and resultant inverter tripping	Production losses due to delay prior to technicians rectifying fault in the field or with inverter. Common cause is voltage peaks (inverter side) that cause inverter to 'trip' / 'cut-out' or an unstable grid connection.
Performance issues with the Maximum Power Point Tracking (MPPT) module	Need for regular performance tests during the start-up of the solar park, significant power production losses from PV array can occur due to poor MPPT performance at level of Central Inverter

Bulk capacitor faults &/or overvoltage Capacitors	Electro-mechanical wear & overheating requires unit replacement required
Malfunction of inverter fans	Unit replacement required
String protector fuses damaged	Surge protection causes inverter tripping, shutdown on-going until repaired in the field
AC magnetic contactor failure	Common fault requiring unit replacement
Internal fuses, including DC input fuses	
Internal bus communications breakdown	Unit replacement required
Extended wait times for inverter restart	Problem booster regime DC-DC
Failure AC filter capacitors on inverter output	Unit replacement required
Failure of inverter relay	Unit replacement required
General wear & tear	Usually demands that costly Central Inverters must be replaced every 5-10 years. This constitutes the most expensive element of O&M during lifespan of a PV array. Micro-inverters obviate the need for Central Inverter(s) at installation & their regular replacement thereafter. Inverter shutdowns for a multitude of reasons are the most frequently-occurring problem in SEF's both in a domestic or large-scale setting
Transformer, Charge Controller or overall PV-array Availability:	These issues ‘availability’ will not be addressed here