(2) test case description: use the following HTD canvas]

Title: Dynamic Characterization of Power-Electronics-based-Microgrid (Dyn-PEM)

Author: Salman Harasis
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Test Objectives
Why is the test needed? What do we expect to find out?
Ans:

- **Characterization and testing of DGs dynamic performance for better system dynamic evaluation.**
- **Measuring and quantifying the available inertia level in the system.**
- **Evaluation of the optimal mix of grid forming and grid feeding DGs under dynamic operating conditions.**
- **Emulation some grid anomalies (e.g., sag, swell, and flickering).**

Purpose of Investigation *(PoI)*
The test purposes classified in with terms *Characterization*, *Verification*, or *Validation*
Ans:

- **Determination of the optimal operating modes of different DERs under certain system configuration, load type, and type of sources.**
- **Characterization and verification of system response under different DG types, Grid feeding, grid forming.**
- **Validation of the simulation results under realistic grid conditions.**
- **characterization of the frequency dynamics according to the system specifications.**

Object under Investigation (*OuI*)
"the component(s) (1..n) that are to be qualified by the test"

- **A microgrid system that contains ≥2 DGs**
- **The existence of grid emulator**
- **Distribution lines**
- **Power, voltage, and frequency signals.**

Function(s) under Investigation (*FuI*)
"The referenced specification of a function realized (operationalized) by the object under investigation"

- **Microgrid system level and device level optimization**
- **Inertia quantification of microgrid**

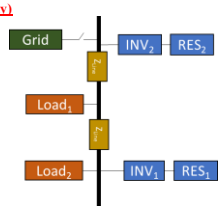
Domain under Investigation (*DuI*)
"the relevant domains or sub-domains of test parameters and connectivity."

- **Low voltage electric power domain that includes measured ac voltage, ac current, dc voltage.**
- **Control domain.**

System under Test (*SuT*)
Systems, subsystems, components included in the test case or test setup.

- **DGs with known capacities, source type (or emulated).**
- **distribution lines.**
- **Fixed load.**
- **Variable load (programmable is preferred).**

(Possible configuration of the microgrid under study)



Functions under Test (*FuT*)
Functions relevant to the operation of the system under test, including FuI and relevant interactions btw. OuI and SuT.

- **DGs with Q-V and P-f controllers.**
- **DGs works under different loading conditions (by having variable loads),**
- **DGs with their power/voltage/frequency are accessed to be measured. (Instantaneous current and voltage signals).**

Test criteria *(TCR)*
Formulation of criteria for each PoI based on properties of SuT; encompasses properties of test signals and output measures.
-instantaneous voltage and current profiles of each DG, the impedance of the lines, the dc link voltage and frequency measurement.
- transient response of a step load change (includes current overshoot, settling time).
- plug and play capability of DER.

target metrics
Measures required to quantify each identified test criteria

- **ΔP (the difference between the actual and scheduled power)**
- **Δf (the difference between the actual and nominal frequency)**
- **ΔV (the voltage deviation)**
- **Actual inertia value calculated/measured.**

variability attributes
controllable or uncontrollable factors and the required variability; ref. to PoI.

- **Realistic PV generation and load variation.**
- **Communication delay.**

quality attributes
threshold levels for test result quality as well as pass/fail criteria.

- **Restoring the original operating conditions after clearing a disturbance. (Successful test).**
- **System frequency and voltage restoration under dynamic conditions (≤10 seconds). (Successful test).**