Ni-Cad battery testing for cycling application

Jack Kopytek
OPG Pickering B Nuclear Station
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Application example:

- Two Ni-Cad battery banks for standby generator black start application.
- Battery # 1: 92 cells, 230 Ah at C5 for supplying 125 Vdc control loads
- Battery # 2: 28 cells, 280 Ah at C5 for starting emergency generator
- Standby generator black test start every 3 weeks
- Additional 15 to 20 black starts a year are expected on each of standby generators

Why Ni-Cad battery is chosen for this application:

- Cycling application
- No issues with Ni-Cad battery substantial capacity degradation at low temperatures
- Expected low maintenance except battery water consumption.

Standby Generator Battery testing program objective

- To ensure that both battery banks are able to perform their required duties at any given time
- To predict battery end of life and replace them before any battery failure can be detected during Standby Generator black start test

Battery Load Profile:

- Bank # 1 92 cells: 87 amps for first 28 minutes + 235 amps for the next 0.1 minutes + 101 A for additional 1 minute with voltage not lower than 105 V during battery discharge
- Bank # 2 28 cells: battery bank load profile is 756 A for 4 minutes with voltage not lower than 28 V during battery discharge

Capacity Discharge Test specification as per IEEE 1106 Std guidelines:

Battery # 1

232 amps down to 105 V (92 X 1.14 V per cell) for 30 minutes

Battery # 2

959 amps down to 28 V (28 X 1.0 V per cell) for 5 minutes

Battery Initial Condition for Testing (IEEE Std 1106 – 2005)

- Have battery on float for at least 12 weeks before last discharge
- Complete high rate charge more than 1 day and less than 30 days before start of the test
- Record all cell voltages, correct problems with low voltage cells
- Check all battery connections

Battery Testing according to IEEE Std 1106 – 2005 recommendation

- Prepare battery for test as outlined in slide 6 of this presentation
- Discharge battery to required end voltage using constant current
- Use rate adjusted (preferred) or time adjusted method to calculate battery capacity.

Problem with applying IEEE 1106 Std to test Ni-Cad for cycling application:

- Unable to comply with requirement to have battery on float for at least 12 week since the last battery discharge
- Consequences of not complying with this requirement is having battery testing results not be representative to “normal” operation with prolonged float charging

What is battery manufacturer recommendation:

Follow the factory manual instruction for battery testing:

- Discharge battery bank at 0.2 C5 rate down to final average of 1.0 V per cell
- Charge battery 200% (i.e.: 200 Ah for 100 Ah battery)
- Discharge battery at 0.2 C5 rate down to 1.0 V per cell

How to calculate battery capacity (Ni-Cad Manual):

Ni-Cad battery manual info:

"Discharge at 0.2 C5 till 1.0 v per cell. The overall state of battery can be seen, and if individual cell measurements are taken, the state of each cell can be observed" ….???

Verbal response from manufacturer. Calculate capacity per formula below:

C= [t (test)/ 5 hour] x 100%

Misalignments between Ni-Cad Manuals and IEEE 1106 -2005 Std:

- IEEE 1106 STD has no provision for testing Ni-Cad cycling application battery banks
- IEEE 1106 STD recommends different capacity testing method than majority of Ni-Cad factory manuals
- Ni-Cad battery manuals are not clear how to calculate battery capacity

Conclusion:

- Include in the next revision of IEEE 1106 STD method for testing Ni-Cad cycling application battery banks. Majority of Ni-Cad battery applications.
- Align IEEE 1106 STD and Ni-Cad factory manuals with respect of Ni-Cad capcity test methods.
- Ni-Cad battery manufacturers to provide clear instructions how to calculate battery capacity.