Taper Effect on SXU ISRDD Coil Integrals

The ISRDD coils on the SXR undulators have been measured in the tunnel, right next to each undulator, since February of 2020. The measurements are referred to as Tunnel measurements, as opposed to the Upstairs measurements made from the service buildings, after long haul RG-58 cables were pulled in August of 2020. These two sets of measurements have been occurring together since September 2020 and the number offset for the runs is 7, with the first Upstairs measurements happening within a day of the 8th Tunnel measurements. During the 13th Tunnel measurements (6th Upstairs), the taper of some of the undulators had been set to a non-zero values and this caused the ISRDD coil integrals to change noticeably. The taper was noticeable for the SXR undulators in cells 33, 34, 46, and 47. Looking at the effect that these tapers had on these undulators we can get an idea of the effect any amount of taper can have on have on an SXR undulator. To find the delta integral change for each of these undulators, the average of the measurements that were before and after the taper measurement will be used.

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| --- | --- | --- | --- | --- | --- | --- |
| SXR Cell | Mean Integral Run 12 and 14  (Vs) | Integral Taper Run (13)  (Vs) | Taper  (mm) | Delta Normalized Integral Change (Mean B&A - Taper) /(Mean B&A) | Delta Integral/Taper  (Vs/mm) | Delta Normalized Integral/Taper  (1/mm) |
| 33 | 1.4326e-01 | 1.4310e-01 | 0.0226 | 1.1427e-03 | 7.2434e-03 | 4.9898e-02 |
| 34 | 1.4230e-01 | 1.4215e-01 | 0.0226 | 1.0884e-03 | 6.8531e-03 | 4.8372e-02 |
| 46 | 1.4347e-01 | 1.4334e-01 | 0.0189 | 9.2414e-04 | 7.0151e-03 | 4.9419e-02 |
| 47 | 1.4279e-01 | 1.4266e-01 | 0.0183 | 9.4435e-04 | 7.3686e-03 | 5.1046e-02 |
| **Mean** |  |  |  |  | 7.1200e-03 | 4.9684e-02 |

The mean value of the Delta integral per taper value, in mm, allows us to see how well the taper must be known for the ISRDD coil measurements to be unaffected. If the error limit is set to 0.5x10-4 then the ceiling for the taper is 0.5x10-4 /4.9684e-02 = 1.0064e-03 mm or 1 micron. So the taper must be set to less than a micron for the measurements to be unaffected.