

Antineutrino detection systems show potential as a non-intrusive, tamper-proof monitoring tool for nuclear reactors. Mobile antineutrino detection systems are especially attractive as an emerging safeguard for their ease of implementation and flexibility to safeguard any type of reactor facility. In theory, these systems can confirm on/off status, monitor thermal power levels, and verify the isotopic inventory of any nuclear fission reactor. The extent of these capabilities depend on a wide variety of factors, such as reactor designs of interest, detector characteristics, and site-specific attributes. In this work, we explore these reactor, detector, and site parameters to gauge how they influence the predicted collection period requirement, or the onsite system measurement time required to verify the reactor condition. The collection period requirement was quantified through a profile construction statistical method, in which simulated antineutrino spectra were given likelihood values of belonging to different reactor operation modes. Our results indicate that a reasonably-sized, near-field, mobile antineutrino detection system can confirm On/Off status on the order of days to minutes. However, for scenarios in which a frequent background event rates are largely uncertain, the collection period requirements become unfeasible.

Mobile antineutrino detection systems, unlike previously deployed stationary near-field antineutrino detection systems, can leverage varying reactor-detector standoff distances to isolate events due to background. From a two-position measurement, the reactor status can be deduced without the need for any reactor-off period. This type of system also introduces a novel parameter of interest in which the system can be balanced between antineutrino measurements at the near and relatively far standoff distances. Our results indicate that a near equal amount of measurement time should be spent at both of these standoff distances to optimize the overall collection period requirement.