The ATOMKI anomaly, a 5σ excess in ^{8}Be decays, suggests a 17 MeV Z' boson ($X17$). We present a $U(1)'$ extension of the Standard Model with non-universal lepton couplings that explains this anomaly while evading constraints from $(g-2)_{e,\mu}$, beam dump experiments, and neutrino scattering. By analyzing non-standard neutrino interactions (NSIs) mediated by the Z', we derive stringent limits from IceCube's atmospheric neutrino data, which enforce near-universality in ν_μ–ν_τ vector couplings and restrict viable parameter space. Our results identify benchmark scenarios where the $X17$ boson survives all experimental bounds, highlighting the critical role of axial-vector couplings and the interplay between low-energy anomalies and high-energy neutrino observations.