NHTSA – Biomechanical Assessment

NHTSA – Human Injury Research Division performed computer simulations of the AHR deployment to evaluate the risks of skull fracture as well as Brain injury. A human model was position in different ways, including head back facing AHR straight and at an angle (to maximize the probability of head rotation that could lead to higher risk of brain injury). To assess the risks of skull fracture and brain injury we used head injury criterion (HIC15) and brain injury criteria (BrIC) respectively. Figure B shows the maximum achievable value of HIC15 in our simulations was 107.217, which happened to correspond to the maximum values measured in physical tests of AHR deployment with HIII test dummy. The physical tests were performed at VRTC.

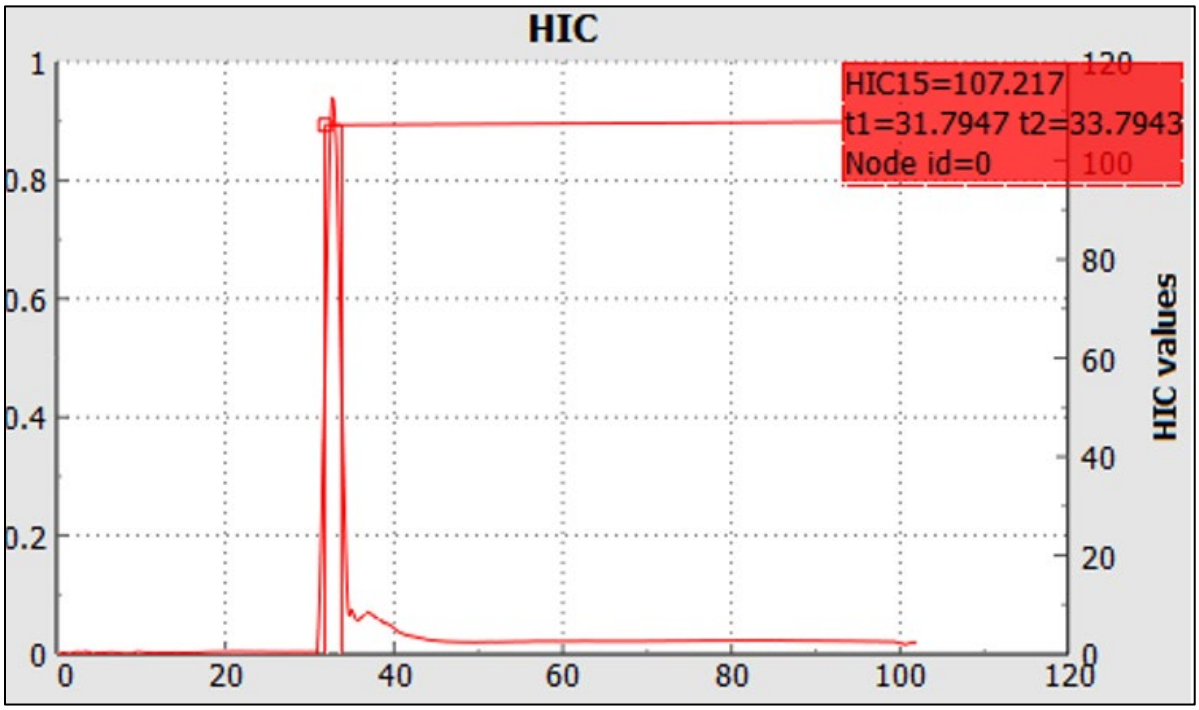

Figure B: Head Injury Criterion (15 ms window) – HIC15

A concern NHTSA had was the loading scenario in which the head of a passenger is positioned at an angle to the striking force from the headrest that could potentially induce head rotations large enough to cause brain injury. This kind of scenario may occur if the front passenger turns their head to speak with a passenger in the rear seat when the headrest deployed. To evaluate this scenario, a study estimated forces acting on the head due to the headrest deployment as well as resulting three-dimensional (3D) head rotational kinematics – this was necessary to calculate the maximum value of BrIC. The stiffness of the AHR cushion and well as impact velocity were varied such that HIC15 values were matching the maximum of those measured in the experiments. The time histories of the head angular velocities are shown in figure C together with the maximum achievable value of BrIC. The maximum BrIC was recorded when the head was positioned at an angle to the striking AHR. The maximum BrIC was 0.15 indicating a very small probability of concussion or any other brain injury.

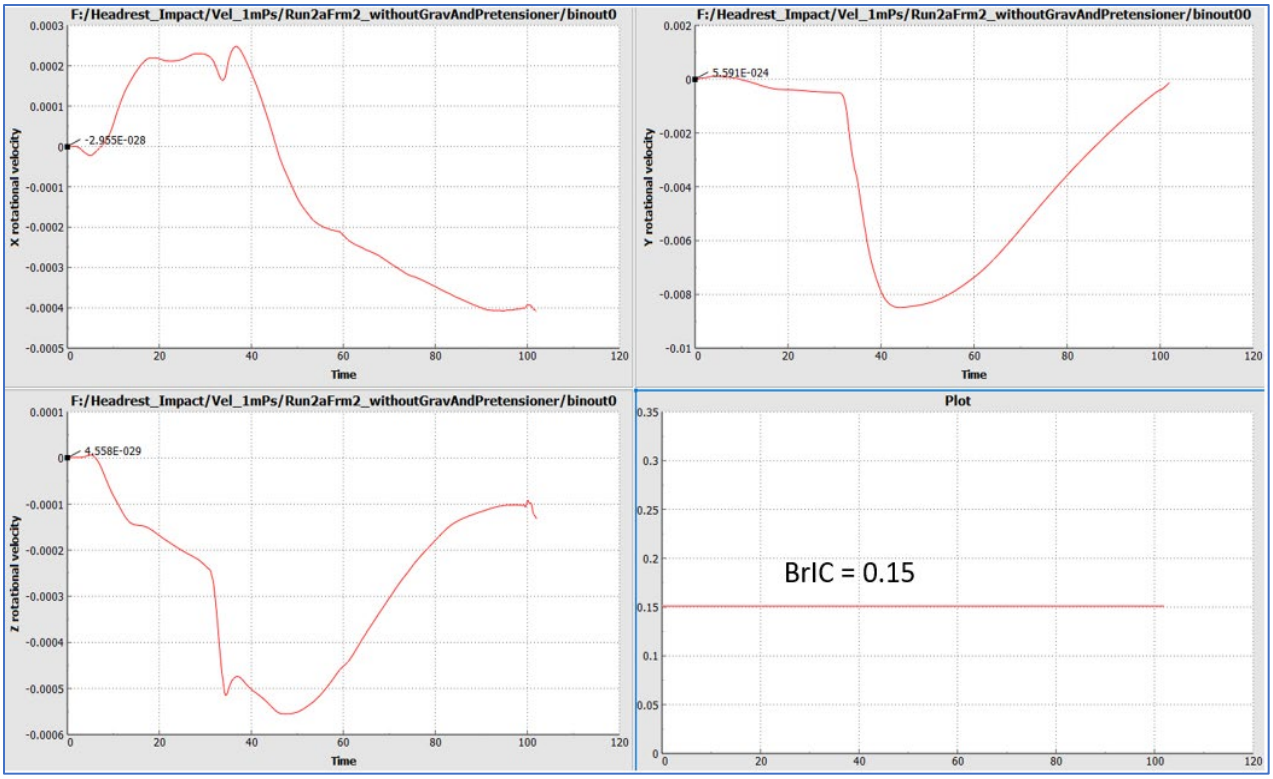

Figure C: 3D Head Rotational Velocity vs Time and the value of BrIC.