B. COLLECTIONS OF INFORMATION EMPLOYING STATISTICAL METHODS

Congress directed the Department of Transportation (USDOT) to conduct research that will provide a better understanding of the causes of motorcycle crashes in Section 5511 of the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU) Pub. L. 109-59. The legislation required the Secretary of Transportation to provide grants to the Oklahoma Transportation Center (OTC) for the purpose of conducting a comprehensive, in-depth motorcycle crash causation study using the common international methodology for in-depth motorcycle crash investigation. (This methodology was developed by the Organization for Economic Cooperation and Development (OECD) to foster uniform procedures in the investigation of motorcycle crashes). As a result of the legislative language, very little freedom is provided for determining the methods of data collection or the data elements included in the final database.

The OECD methodology is a comprehensive approach to investigating motorcycle crashes. The 649 page methodology calls for the investigation of crashes of all severities and the collection of exposure data in the form of controls (two matched non-crash involved vehicles for every similar crash-involved vehicle). Crash investigations specify interviews with motorcycle operators, passengers and the drivers of other-involved vehicles. Human factors topics range from rider experience, licensing and training to fatigue, drug and alcohol use, trip purpose, use of protective clothing, and risk-taking behaviors.

B1. DESCRIBE THE POTENTIAL RESPONDENT UNIVERSE AND ANY SAMPLING OR OTHER RESPONDENT SELECTION METHODS TO BE USED.

B1.1 Potential Respondent Universe

The sampling frame is the set of all police-reported traffic crashes that include motorcycles in the United States. An ideal sample would be drawn randomly from the 103,000 such police reported crashes that occur each year (NHTSA, Traffic Safety Facts, 2005). However, such a sampling plan would require research teams to respond to a randomly drawn sample of those 103,000 different crash locations, something beyond the budget for this project. Alternatively, a clustered sampling plan could be used similar to that used in the National Automotive Sampling System. However, this also is well beyond the budget allotted by Congress for this study. Therefore, operational considerations dictate that a limited geographic area be selected from which to draw the crash sample. The plan is to draw from police jurisdictions in a single geographic area. This area will cover diverse demographic and geographic characteristics and experience substantial numbers of motorcycle operators year-round. Orange County, California was selected as the data collection region because of the large number of motorcyclists with diverse population and geographic characteristics. Furthermore, the pilot study was successfully conducted in this region and a relationship with local law enforcement was already established. Precedents exist for performing studies on vehicle crashes from investigations conducted in a single geographic location. Nevertheless, it is recognized that this study is not nationally representative, although it is anticipated that the most common crash types and most common antecedent conditions leading up to the acquired crashes will be represented in the study. Nonetheless, the single location will be considered as a limitation when using crash data collected from this study and as a result, language will be included in reports and analyses that use this data to acknowledge this limitation:

"The Motorcycle Crash Causation Study chose southern California as the data collection site because of previous successes in collecting crash data in this region, in addition to climate and budgetary considerations. This single data collection location is a limitation of the study in that the distribution of causative factors in motorcycle crashes in southern California may not represent the entire United States."

B1.2 Crash Sample Acquisition

The research samples for the pilot study and for the Main Study include all police reported, motorcycle-related crashes that occur in the selected police jurisdictions within the study period. To date, 223 cases have been completed, including the collection of two control rider interviews pre case. Additionally, 39 cases are currently under investigation. The current Work Plan supports the collection of 350 total cases. However, given the possibility for future funding and cost savings, FHWA is requesting approval for a total of a MAXIMUM of 1200 crash investigations, along with 2,400 matched case controls. A sample size of 1200 was chosen because it represented the "ideal" sample size as described by the Project Working Group. The current expected sample size of 350 crash cases with a corresponding 700 control rider interviews is a reflection of the available budget and cost per case. While this sample size is significantly smaller than that requested by the Project Working Group, it is still large enough to provide a statistically-significant investigation of many crash-causing factors and research questions posed by the Project Working Group, including rider licensure, rider age, and rider experience. A power analysis was conducted based on the distributions of crash and control proportions from the MAIDS study conducted in Europe, which used the same OECD data collection methodology as the Main Study discussed here. This analysis assumed a $\beta=0.80$ and an expected significance test limit of $\alpha=0.05$ using a two-tailed test for significant differences between two populations. In the MAIDS study, 66% crash involved riders were carrying a valid motorcycle license as compared to 75.6% of control riders. Assuming the same distribution in this study, a sample size of 275 crash-involved riders and 550 control riders are required to see a statistically significant result. Similarly, 43.4% of crash involved riders were between the ages of 16-25 years old as compared to 32.8% of control riders. This would require a sample size of 259 crash-involved riders and 518 controls for this study to exhibit a significant difference. Finally, only 24.0% of crash involved riders had over 98 months of riding experience as compared to 46.7% of control riders. This would require a sample size of 59 crash-involved riders and 118 controls for this study to exhibit a statistically-significant difference in this study.

The motorcycle-related crashes are identified through cooperative agreements with the selected police jurisdictions. The crash investigators are notified by police dispatchers when an applicable crash is reported, and they initiate their investigations on-scene in concert with first responders.

Data element definitions were specifically tailored for this study to be in-line with those collected by National Automotive Sampling System and the National Motor Vehicle Crash Causation Study have been identified so that they can be cross-referenced. This allows the results from the current study to be compared to the in-common nationally representative data from these other NHTSA programs. This study is anticipated to provide more detailed information on motorcycle crashes and motorcyclist characteristics than is available in the other programs because of the unique data elements that will be collected pertaining to motorcycle and operator factors. Examples include operator training, experience and behaviors, and specific motorcycle features and condition.

B1.3 Control Sample Acquisition

The collection of control data also has antecedents in passenger vehicle safety research projects and motorcycle research projects. The current study uses a more stringent procedure than either of these studies for acquiring similarly at risk motorcyclists by capturing data from non-crash involved motorcyclists and passenger vehicle drivers (control subjects) matched on location, travel direction, and day of week, and time of day as the selected crash-involved parties. Acquiring data on controls matched this way (that is, similarly-at-risk controls) allows for the calculation of relative risks that can be used for developing countermeasures. In the Hurt study in the 1970s, this approach identified several significant risk factors for crashes. One was that riders who had received formal training were less likely to be involved in a crash or to suffer serious injury. Also, crash involved motorcyclists used daytime headlamps only about half as often as did those in the control group.

B2. DESCRIBE COLLECTION OF INFORMATION PROCEDURES.

The OECD identifies two complementary procedures to be performed for acquiring the data needed to understand the causes of motorcycle crashes. The first of these is the traditional in-depth crash investigation that focuses on the sequence of events leading up to the crash, and on the motorcycle, rider, and environmental characteristics that may have been relevant to the crash. The second procedure, known as the case-control procedure, complements the first. It requires the acquisition of matched control data to allow for a determination of the extent to which rider and driver characteristics, and pre-crash factors observed in the crash vehicles, are present in similarly-at-risk, non-crash involved control vehicles.

Such a dual approach offers specific advantages to the understanding of crashes and the development of countermeasures. The in-depth study of the crash by itself allows for analysis of the events antecedent to the crash, some of which, if removed or altered, could result in a change in subsequent events that would have led to a non-crash, or reduced crash severity outcome. For example, an in-depth crash investigation may reveal that an automobile approaching an intersection was in a lane designated for straight through traffic only, but the motorist proceeded to make a left turn from that lane into the path of an oncoming motorcycle. That finding can, by itself, be used to develop countermeasures, and does not require matched control data. However, acquiring matched control data from similarly-at-risk riders and drivers provides additional critical information about crash causes that cannot be obtained if only crashes are examined. Perhaps the crash-involved motorcycle operator was not using daytime running lights, but the matched controls both used such conspicuity features.

B2.1 Crash Investigation Procedures

Once a crash notification has been received, several activities are initiated by the research team. Crash investigators immediately locate, visit, measure, and photograph the crash scene (while the vehicles are still there, to the extent possible). They locate, inspect, and photograph all involved vehicles. The investigators conduct an in-person or telephone interview with each involved person or surrogate. Because inclusion in the research is strictly voluntary, the investigators will use a script similar to the following:

“Hello, we are conducting a study of motorcycle safety for the FHWA and would like to ask you a few questions. This is expected to take about 30 minutes of your time. All information that you

provide will be kept strictly confidential. We do not include any names, addresses or other personal identifiers in our records".

Injury information from hospital or emergency room records or medical examiner reports is obtained and encoded for all injured victims. Surrogate interviews are used when a person is not able to be interviewed because of hospitalization or incarceration. Note that participation in the study is completely voluntary and the confidentiality safeguards described in Section A above will be strictly followed. During each activity the researchers record information on the appropriate crash, vehicle, and environment data forms. No personal identifiers are ever entered into any system of records.

B2.2 Control Data Collection Procedures

For the control data, researchers interview motorcycle operators and motor vehicle drivers who pass by the site of a selected crash either for one hour immediately following the crash occurrence, or at one week after the crash at the same time of day. The timing of the control data collection effort is determined by the current circumstances at each site (traffic congestion, police permission, and crash-data availability). Priority is also be given to obtaining crash data as rapidly as possible before it can be affected by traffic, weather or clean-up activities. If weather (or other) conditions differ substantially on the week following the crash, then the control sample collection will be moved to the week following.

Interviews are conducted with the operators of the motorcycle and the drivers of the targeted other vehicles. Motorcycle inspections are also conducted so that the type and condition of the vehicle can be recorded. Two control motorcyclist interviews will be captured for each single vehicle motorcycle crash. For two-vehicle crashes, one control motorcyclist and one control motor vehicle driver (similar to the crash-involved vehicle) will be interviewed. The number of controls captured per crash is relatively small because increasing the control sample size beyond the size of the crash sample yields diminishing returns on statistical power. One general problem these kinds of studies face is response bias. This problem is recognized and will be acknowledged in the final report.

B3. DESCRIBE METHODS TO MAXIMIZE RESPONSE RATES AND TO DEAL WITH ISSUES OF NON-RESPONSE.

Motorcycle operators, passengers and the drivers of other involved vehicles are interviewed at the scene of the crash whenever possible. If these individuals have been medically transported, arrested or are otherwise not available for immediate interview, follow-up efforts will be initiated. Occupants are contacted by telephone to arrange for an in-person interview if one can be arranged. Telephone interviews are conducted only when necessary. Several methods are used to maximize response rates. Researchers call at varying hours (often in evenings or on weekends) until they have located the driver, operator, or passenger sought. When the person is unavailable (for medical or legal reasons), other family members or witnesses may be contacted to provide whatever limited information is available to them. Each researcher is given special training in interviewing. This increases the possibility that crash-involved persons will cooperate once they have been located and contacted. At least four follow-up phone calls will be made to reach necessary respondents.

Attempts are made to recruit control drivers for interviewing at site-time matched locations (see

Section 2.1.2). During the designated time period, the recruitment effort will continue until a control driver has agreed to participate, or the matched time period has ended. In the latter case, the same recruitment effort will be repeated at the same location during a second time period a week later, and if needed in subsequent weeks.

It is anticipated that some information items may not be obtained even for riders who are willing to participate in the research. The contractor plans to impute such missing item responses using traditional methods of imputation such as the hot deck.

Regarding the problem of refusals and bias that may be introduced by non-responders, it should be noted that response rates have been reasonably high in the Main Study. In total, the contractor has initiated 369 cases. Of these, 107 were dropped. However, only 70 (19%) were dropped because of a refusal to participate. The other dropped cases were often the result of a lack of access to medical records or the inability to locate the crash-involved bike (often sold post-crash). In a recent automotive crash study focused on alcohol involvement that was conducted by NHTSA (see Compton, R. P., Blomberg, R. D., Moskowitz, H., Burns, M., Peck, R. C., & Fiorentino, D., Crash Risk of Alcohol Impaired Driving, in D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs*) refusal rates were 7.55% for crash drivers and 2.12% for control drivers. For NHTSA's National Automotive Sampling System (NASS) annual crash study, refusal rates in 2006 were in the 26% range. Nonetheless, the matter of analyses to be performed on sub samples, FHWA recognizes that the matter of non-response is to be given careful attention with respect to the potential of bias when sample sizes are effectively reduced in sub sample analyses.

B4. DESCRIBE ANY TESTS OF PROCEDURES OR METHODS TO BE UNDERTAKEN.

The NHTSA Pilot Study served as a test of the procedures to be used for the Main study. Minor modifications to the methodology were made to accommodate differences in the units of measurement and language, but as a whole, the methods to be employed in the main study are those outlined in the OECD methodology. However, during the pilot study, the most challenging aspect of data collection was getting the control riders to stop for an interview. After the completion of the Pilot Study, a significant amount of time was spent discussing possible solutions to this issue. These discussions included a liaison for the OECD protocol, the crash investigators, and the project management team. The discussions resulted in a number of possible solutions which the crash investigators have implemented in the main study with great success. Improvements to the protocol included hiring a third investigator, efforts to increase the visibility of the control collection site, and utilizing the influence of study partners and associated outlets to increase awareness of the study within the motorcycle community.

B5. PROVIDE THE NAME AND TELEPHONE NUMBER OF INDIVIDUALS CONSULTED ON STATISTICAL ASPECTS OF THE DESIGN AND THE NAME OF THE AGENCY UNIT, CONTRACTOR(S), GRANTEE(S), OR OTHER PERSON(S) WHO WILL ACTUALLY COLLECT AND/OR ANALYZE THE INFORMATION FOR THE AGENCY.

B5.1 Statisticians Consulted

Ms. Roya Amjadi, Safety Research and Development, reviewed the statistical approach for FHWA. She can be reached at 202.493.3383

Paul Zador, Ph.D, Senior Statistician, Westat Corporation provided consulting services. Tel. 301.294.2825.

Abe Ahmad, Ph.D. Head of Statistics, Oklahoma State University provided analyses regarding power and sample size. He can be reached at 405.144.9659.

B5.2 Agency, Contractors, Grantees

FHWA

Craig Thor, Ph.D, Office of Safety Research and Development, Federal Highway Administration (FHWA), is responsible for the large-scale study. He can be reached at 202.493.3338.

Contractors

The cooperative agreement for the Motorcycle Crash Causation Study (DTFH61-06-H-00034) was awarded to the Oklahoma Transportation Center (OTC). Dr. John Nazemetz is the Project Director and Principal Investigator. He can be reached at 405.744.9137.

OTC has named Westat, DSI, James Oullette, DRI, and CID as subrecipients under the cooperative agreement.

Westat. Ms. Frances Bents is the Project Manager for data analysis. She can be reached at 240.314.7557.

Westat
1600 Research Blvd.
Rockville, Maryland 20850

Dynamic Science, Incorporated (DSI). Mr. James Perry is the Field Manager for data collection. Michael Kaszubowski is the Director of Contract Management. He can be reached at: 602.995.3700

Dynamic Science, Inc.
8433 N. Black Canyon Highway
Phoenix, Az. 85021

James Oullette, consultant, will assist with training, data quality control, and helmet inspection. He can be reached at: 310.306.9194

James Oullette
8117 Manchester Ave. #668
Playa Del Rey, Ca. 90293

Dynamic Research, Incorporated (DRI). Dr. Terry Smith, principal scientist, will assist with training, data quality control, and OECD coding. He can be reached at: 310.212.5211

Dynamic Research
355 Van Ness Ave.
Torrance, Ca. 90501

CI-Dynamics, Incorporated (CID). Helmet testing will be conducted by CI-Dynamics. David Thom is the Principal Scientist. He can be reached at: 310.414.0449

CI-Dynamics
149 Sheldon St.
El Segundo, Ca. 90245