

June 26, 2012

John Howard, M.D.
Director
The National Institute for Occupational Safety and Health
Patriots Plaza 1
Suite 9200
395 E Street, S.W.
Washington, DC 20201

Dear Dr. Howard:

The report letter that follows offers an analysis and perspective of the NIOSH's Agriculture, Forestry and Fishing Research Program (AgFF) since its first review by the Board on Agriculture and Natural Resources of the National Research Council and Institute of Medicine in 2008. The ensuing five years have seen implementation of the NORA that was in place, but not yet fully deployed at the time of the initial review, internal adjustments within NIOSH that placed the AgFF Program under synergistic leadership, and significant change in both national public policy and scale of worksite adjustments such as worker organization patterns and technology use in the overall sector.

The review panel that I convened responded to an ambitious time frame assigned for this review, and conducted its scoring of program relevance and impact in conformance with procedures established by the evaluation *Framework Committee* of the NRC & IOM within the National Academies. I have, as its chair, synthesized perspective about salient AgFF Program activity and foci, and trust that this work contributes to NIOSH's mission within the targeted sector.

The panel's work was admirably supported by members of your staff who produced documents on short order, and set in motion the process to create the *AgFF Research Program evidence package*. A special note of thanks goes to Dr. George Conway and Captain Brad Husberg who never tired in their support of panel functions. I also acknowledge the effort of staff within NIOSH who provided verbal testimony, and the National Children's Center and each of the regional agricultural research and education centers who provided useful written descriptions of salient program activity and in-person comment about their programs. The panel and I are deeply grateful for all effort that was committed to this review process.

Our nation's agricultural workers and producers, fisherpersons, and forestry workers labor in circumstances very different from most of the nation's workforce. I join you in the belief that AgFF workers deserve safe and healthy worksites.

Sincerely yours,



Paul D. Gunderson, Chair
AgFF Review Panel

**COMMENTS ON THE AGRICULTURE, FORESTRY, AND FISHING (AgFF) NATIONAL
RESEARCH PROGRAM SPONSORED BY THE NATIONAL INSTITUTE FOR
OCCUPATIONAL SAFETY AND HEALTH (NIOSH), CENTERS FOR DISEASE CONTROL
AND PREVENTION (CDC)**

This report letter offers comments concerning the National Institute for Occupational Safety and Health's national research program that targets the U.S. agriculture, forestry, and fishing economic sector. The comments reflect a sense of the review panel convened by its chair to assist in review of the performance of this program from 2006 forward, however the chair is ultimately accountable for all content within this letter. This program review followed a National Research Council and Institute of Medicine review of the program from its inception in 1992 to 2006 (NRC & IOM, 2008). It is important to note that some facets of the current program were reviewed from 2004 forward given the paucity of data for the first review that commenced in early 2006 and was completed in late 2007. NIOSH has continued its commitment to examining the relevance and impact of its programmatic work among the nation's working populations, and it is commended for its insistence upon such basis for evaluation.

The evidence package entitled "National Institute for Occupational Safety and Health – Office of Agriculture Safety and Health; Five Year Review, May 30-31, 2012" provided by NIOSH was carefully reviewed prior to my convening the panel for its review meeting on May 30-31, and June 1, 2012. The panel benefited enormously from the comprehensive and detailed evidence package prepared for its use, as well as the thorough briefings and informative discussions held during the course of its review meeting (see meeting agenda, Appendix B). At that meeting the panel heard presentations from key NIOSH staff, presenters from extramurally-funded regional agricultural safety and health research, education, and outreach centers, and the Director of the National Children's Center for Rural and Agricultural Safety. Following those presentations I convened executive sessions of the panel to assess and score the AgFF Program's relevance and impact and discern other salient perspectives.

Congress recognized four decades ago that NIOSH conducts research, experiments, and demonstrations relating to occupational safety and health and successfully develops innovative methods, techniques, and approaches for dealing with such problems (U.S. Congress, 1970). Its role is one of exploring underlying etiologies of occupational disease and injury, identifying criteria for setting worker exposure standards, researching and conducting evaluation of preventive technologies and patterns of work organization, anticipating emergence of new or additional exposures, and transmitting advice to both public and private sector organizations. It does not possess regulatory authority; rather its force of expertise is brought to bear upon existing and emerging worksite exposures. Therefore, in 1990, the U.S. Congress directed NIOSH to develop an agricultural safety and health program that included surveillance, research, and intervention activity capable of addressing the excessive rates of injury and disease among populations exposed to agricultural risk (U.S. Congress, 1990a & 1990b). Further, in 1996, children exposed to agricultural risk (typically working within agricultural enterprises) were specifically targeted through creation of a national center, relevant surveillance, and development of work guidelines and communication strategies capable of reaching agricultural populations (U.S. Congress, 1996); this program facet was subsequently folded into the AgFF research program.

Forestry and fishing are implicitly included within the sector as the U.S. Census Bureau's *North American Industry Classification System (NAICS)* classifies economic units that have similar production processes in the same industry (BLS, 2001b). Agriculture, forestry, and fishing are grouped together because they entail harvesting of fiber, food, and fuel. Accordingly, it is

important to acknowledge the role of P.L. 100-44 and P.L. 111-281 in which the U.S. Congress addressed fishing vessel safety; although it must be recognized that the U.S. Coast Guard has a long history of such activity given that it first engaged safety issues in 1942 (U.S. Congress, 1988). Other non-legislative, but helpful, activity by NIOSH, including surveillance, design and development of technology has occurred across time. A congressional mandate for forestry is missing, however NIOSH, to its credit, has cooperated in technological development of safer equipment, hearing protection, and state-level surveillance activity.

Five-Year Review Panel Study Charge

In January, 2012, the Office of the Director, NIOSH, directed that an evaluation be conducted of the AgFF program's contribution toward reductions in workplace hazardous exposures, illnesses, or injuries. This activity constituted a re-review of the AgFF program, given the degree to which the program had undergone change resulting from (1) implementation of NORA-2 across the sector, and (2) programmatic response to recommendations for AgFF Program improvement emanating from the initial NAS review. The *Review Panel* was tasked by its chair with review and assessment of the program's performance since 2006 and providing an integer score of its *impact* and its *relevance* (See Appendix A). En-route, certain recommendations for program improvement across time were developed, including identification of emerging research opportunities and priorities for future deployment. I have summarized those recommendations on pages 4 through 17; selected references that buttress those recommendations are provided on pages 18 through 21.

Five-Year Review Panel Composition

The *Five-Year Review Panel* (n = 10; see panel membership, Appendix C) was constituted of two new members and eight returning members from the original NAS Committee (n = 12) to Review the NIOSH Agriculture, Forestry, and Fishing Research Program convened under the auspices of the Board on Agriculture and Natural Resources of the National Research Council in 2006. Four members of the original Committee were unable to serve during this review due to conflicts of interest or conflicting meeting and travel schedules.

AgFF Research Program Evaluation Time Frame

The period covered by this review began in 2007 and continued to the most current date (May, 2012). When developing recommendations about present and future AgFF surveillance activity, program evidence pertaining to NIOSH effort dating back to 2004 was used.

AgFF Research Program Evaluation Approach

The AgFF Program was evaluated by assessing (1) its impact on reducing workplace illnesses and injuries, and (2) the relevance of its work to improvements in occupational safety and health within the sector. The Institute of Medicine and National Research Council's *Framework Document* reflects the terminology and organization of NIOSH's logic models (IOM & NRC, 2009) that are deployed to characterize its process when designing and implementing the AgFF Research Program (NIOSH, 2012). Accordingly, the evaluation process depicted within the *Framework Document* was used...virtually identical to the approach used in the first review of the AgFF program in 2006-2007. En-route, its chair moved the *Five-Year Review Panel* through an examination of AgFF goals, inputs, activities, and outputs when assessing relevance of the AgFF Program's research. Assessment of the impact of the AgFF Program's impact involved identification of intermediate and end outcomes.

To inform its deliberations, the panel obtained information from a variety of sources. NIOSH provided an *Evidence Package* (NIOSH, 2012); additionally, program experts from within NIOSH as well as funded extramural centers provided input during open sessions of the panel's meeting on May 30 - 31, 2012. All information was carefully assessed: some led to the identification of research opportunity and future program priorities. In consort with the *Framework Document* and the first NRC & IOM Review Committee's evaluation process, identification of these items was based on expert judgment rather than a formal research needs assessment. In some instances Chapter 2 – “The Ideal Agriculture, Forestry, and Fishing Research Program” (NRC & IOM, 2008) of the NRC & IOM Committee's 2006-2007 AgFF Program assessment was used in order to benchmark the goals and activities of the current AgFF Program. I have summarized the *Review Panel's* recommendations below in a spirit of helpfulness rather than explicit critique, for the complexity of the AgFF worksite sector challenges even the most diligent and well-meaning program effort.

A Summary of The Review Panel's Findings

On the basis of assessment of the evidence collected for this review, I herewith report that the panel scored its assessment of the **relevance of the AgFF Program as 5** because research has been in very high priority areas and is highly relevant to improvements in workplace protection (Note: all scoring employed a whole integer five-point scale where 5 is highest). Additionally, the AgFF Program is engaged in transfer activities on a very significant level. Further, considerable progress has been made in producing intermediate outcomes such as responding to all prior NAS Review Committee program recommendations, development of strategic goals for surveillance, implementation of effective social marketing via its **extramural** research, education, and outreach centers, improvement of stakeholder engagement and partnerships through development of the AgFF NORA Council plan and private-sector organizations such as the Agricultural Safety and Health Council of America (ASHCA), two intramural/extramural workshops and a third pending for program scientists and stakeholders, and development of the National Occupational Research Agenda for the AgFF Program. In particular, the functioning partnership with Agricultural Safety and Health Council of America (ASHCA) contains evidence of program maturity.

The panel scored its assessment of the **impact of the AgFF Program as 4**. Clearly much notable progress has occurred; for example the significant lowering of child death rates due to exposure to agricultural worksite risk, the diffusion of ROPS technology into agricultural worksites, and assessment and promotion of personal flotation device use and adoption of safer technology for the decks of fishing vessels operating in American coastal fisheries. More progress needs to occur within the sector, however further progress awaits maturity of program initiatives, both intramurally and extramurally, and diffusion of research results into (or across) sector worksites and populations at risk.

A dominant impression emerged from review of all evidence: the primacy of both pure and applied research in the mission of NIOSH. The AgFF Program has contributed in a meaningful way from 2007–2012 (the period covered by this review) to improving worker safety and health in the agriculture, forestry, and fishing sector within the U.S.

Overall AgFF Program Comment

The AgFF Program contains five major goals consistent with its initial congressional mandate: (1) conduct surveillance, (2) reduce injuries and illnesses of special (priority) worker cohorts, (3) explore the long-term and chronic human effects of exposures to agriculture-related chemical or physical agents, (4) develop, demonstrate, and provide for diffusion of hazard-control systems, and (5) inform and educate employers and employees about occupational safety and health hazards and control systems. These goals have been addressed by NIOSH and its national and regional centers with emerging vigor and focus since 2007. NIOSH, in particular, has re-organized its program management structure, sharpened internal programmatic focus, used its extramural mechanism to drive priority activity, and generated both invigorated matrix management systems and a NORA agenda for the sector. These are commendable developments. Additionally, it has seriously responded to the eight key recommendations of the NRC & IOM Committee's evaluation of the program in 2006-2007 by initiating agency action remarkably responsive to identified opportunities for program improvement.

The budgetary evidence associated with the AgFF Program suggests most resources are committed to the agricultural portfolio; fewer resources are directed toward fishing, and relatively modest levels toward forestry, likely in conformance with apparent congressional intent. Mechanisms to bring nationally-recognized expertise to the in-house forestry portfolio are underway; perhaps such development may lead to assignment of targeted resources given its high levels of forestry workforce disease, disabling conditions, and injury. Further, it is evident that NIOSH's internal fishing portfolio within the AgFF Program remains functional at an enviable level of (1) energy, (2) collaboration with stakeholders, and (3) targeted priority foci, given its funding level. Elements of the fishing program portfolio are now shared with AgFF regional centers whose jurisdiction includes states with coastal boundaries.

The apparent "balance" between intra- and extramural resource allocations has shifted from the 1992-2006 review cycle. A far greater proportion of all program resources now flow from NIOSH to its national and regional partners that have been organized into recognizable centers. It appears that program outputs parallel such resource assignment; the panel chair leaves judgment of the nature of the overall balance to NIOSH management.

In the commentary that follows, I transmit the sense of the panel relative to AgFF program surveillance, worksite size dilemmas when targeting surveillance or intervention, defining worksite 'populations at risk', use of fotonovela and printed media among workers unaccustomed to use of the English language within American AgFF worksites, emerging animal agriculture production practices and their implications for worker safety and health, forestry and fishing issues and opportunities for research and intervention, and climate change implications within AgFF worksites.

AgFF Program Surveillance

AgFF Surveillance. In its 2008 report, the National Research Council and Institute of Medicine's Committee to Review the NIOSH AgFF Research Program observed "As seen in information provided to the committee, the AgFF Program has struggled to conduct surveillance to identify subjects that warrant the highest priority for attention and has not been able to accurately define the populations that it serves." (National Research Council and Institute of Medicine, 2008; page 168) The current AgFF program has witnessed considerable improvement in coordination of surveillance effort within NIOSH, as evidenced by establishment of the internal NIOSH Surveillance Coordination Group (SCG) and development of the NORA with explicit surveillance goals, action steps, and performance measures), and between NIOSH

and, for example, the U.S. Department of Agriculture (National Agricultural Statistics Service (NASS) effort), or the U.S. Coast Guard (fishermen safety/mortality surveillance). Other potential collaborations with, for example, the U.S. Department of Labor or Department of Commerce are noted, as is the need to shore up future relationships with these agencies and private sector entities so that the AgFF Program possesses more comprehensive coverage of vulnerable populations at risk of sectorial worksite exposures.

The AgFF sector differs from other U.S. worksites in that fixed worksites are not the norm. Rather, work is performed on millions of individual worksites possessed of fluid characteristics, given that the AgFF sector produces fiber, food, and fuel from the nation's natural resource base, including vast acreages of crops, biomass, forests, and open waters, and is constantly evolving and shifting. Accordingly, comprehensive surveillance is markedly difficult and costly to design, implement, and assess. NIOSH shall have to prioritize its surveillance targets given the apparent continued paucity of resources.

Prioritization of resources provides opportunity to (1) critically examine current definitions of "vulnerable working populations" used by the agency, (2) explore limiting characteristics of current USDA surveillance effort on which NIOSH is noticeably dependent, and (3) assess potential use of other sector-to-enterprise-specific sampling frames constructed by private-sector entities as diverse as the sector itself. In the face of such diversity, prioritization is central to planning public health surveillance effort. Focus on a lessor priority target population, as opposed to a more critical target – under public health definition – will set in motion a process across the sector that shall be less than helpful. The panel took note of two such populations - *child labor*, and *hired workers* (see below), and also transmits its sense of an enduring issue within the sector...who should be targeted for surveillance?

An answer to this question can take several forms. For example, in the agricultural arena, nine percent of the nation's farms produce eighty three percent of the value of agricultural production (Hoppe & Banker, 2006). More recently, the 2007 Census of Agriculture finds the largest 5.7% of U.S. farms accounted for seventy-five percent of production (USDA, 2009a), which is less than half the proportion of the largest farms (13.3%) that accounted for seventy-five percent of production just two decades earlier in 1987 (US Census Bureau, 1989). Since the late 1980's, U.S. agricultural production has shifted away from small farms to very large farms and nonfamily farms. It is these farms that employ the vast majority of agricultural labor, including children and youth. Thus, NIOSH must focus, on the basis of sound public health principle, on this worksite setting and may have to consider targeting farm management companies and other types of non-owner/operators such as farm labor aggregators which may entail collaboration by NIOSH with the Census Bureau's "Current Industrial Reports" surveillance initiative and possibly other surveillance activities conducted by the Department of Commerce, and/or key agricultural states whose departments of labor exercise jurisdiction over such entities.

In the 2011-2012 debate over the DOL's proposed "youth farm labor rule" an agricultural organization purporting to represent agricultural producers stated..."The labor department's notification today that it is withdrawing proposed rules that would have prevented many young people from working in agriculture is the right decision for our nation's *family-based* agricultural system." (Schuff, April 30, 2012) (Emphasis added by the panel chair). Any characterization of the nation's agricultural industry as "family-based" in terms of its actual productive output today is unalterably false...the U.S. Congress, in 1985, defined a "family farm" as using less than 1.5 person years of hired labor, hence reflecting an ownership and management pattern exemplified by individual 'hands-on' work and control on a scale that entails $\approx 3,060$ labor hours annually (<http://www.ers.usda.gov/briefing/FarmStructure/Questions/familyfarms.html>). Even the USDA's own Economic Research Service, though it employs outdated political rhetoric to classify agricultural enterprises (for example, a "farm" is defined as possessing income of \$1,000 or more per year from sales of agricultural production), noted in 2005 that low- and medium-sale family farms generated only

nineteen percent of production value, while other “small family farms” – sixty eight percent of all U.S. farms and classified as ‘limited-resource,’ ‘retirement,’ or ‘residential/lifestyle’ – generated much less...nine percent of production value (Hoppe & Banker, 2006). The 2007 Census of Agriculture finds that farms with less than \$20,000 in annual production, comprising over two-thirds (68.5%) of U.S. farms, generated less than 2 percent of total production of food and fiber (USDA, 2009b).

Hoppe and Banker also classified the balance of farms as “family”, though the vast majority of those ‘large-scale’ and ‘very large-scale’ farms were organized as corporations that bear little resemblance to conventional (or historic) family farm structures, size, tax entity organization, or management. It is imperative that NIOSH maintain an independent perspective relative to USDA data need and farm surveillance. The USDA needs to know a good bit about small “family” farms given that they account for ownership of most farm assets – almost entirely composed of land – if only because such entities are custodians of the nation’s largest aggregation of natural resources. However, it is important that NIOSH in its intramural and extramural programs continually adopt its programs to assist the industry as it evolves into larger production units with more classical workforce structures.

NIOSH is commended for its continued use of the USDA’s National Agricultural Statistics Service...it represents one relatively universal, though incomplete, mechanism for surveillance of agricultural worksite risk within the sector given that the USDA has been receptive to repeated requests from NIOSH and a few state- or university-level public health surveillance units to employ its sampling frame while strictly adhering to confidentiality provisions. The NASS is conceptually sound, and its organization, sampling strategies, questionnaire design, data collection schemes, data processing, and dissemination activities remain the envy of most modern nations. However, a re-evaluation of its surveillance mechanisms is in order because (1) portions of the NASS are currently under internal USDA review, in part due to congressional reductions in the USDA budget, and (2) information derived from, for example, the Agricultural Resource Management Survey (ARMS) that depicts farm operator insurance coverage, sources, insurance premium and out-of-pocket cost, has not been complemented with information from the Current Population Survey or the National Health Interview Survey - until very recently. Additionally, the panel recommends a re-evaluation because of (1) respondent bias and non-response to several of the recurrent surveys embedded within the NASS that could impact special add-on questionnaire batteries or other separate AgFF surveys employing a sampling frame extracted from NASS, (2) continued use of older rubrics to characterize agricultural enterprises, and (3) assembly and interpretation by NIOSH of data pertaining to children and youth at sectorial worksite exposure risk.

Non-response issues remain problematic for NIOSH surveillance purposes. While NASS has deployed imputation methodology that accounts for respondent non-response, and engages considerable effort to insure its sampling frames possess completeness, deficiencies persist. In part, these result from large and very large agricultural operations reeling from response burden under NASS interview strategies (NRC, 2008), including agricultural operations (hence worksites) that refuse to respond to NASS questionnaires, whether administered by mail or by telephone. Unfortunately, the result is error when the USDA develops, for example, such basic parameters as “cropping intentions,” “crop yield” forecasts, or estimates of “animals on feed.” This, in spite of employing accepted statistical procedures such as use of calibrated summaries for adjusting for unit nonresponse and under-coverage.

The NASS has so far not fully exploited for surveillance purposes emerging high tech media now in routine use by the sector of American agriculture producing 75 percent or more of the nation’s fiber, food, and biofuel. This stands in contrast, for example, to *Crop Life America* or the precision agriculture industry, both of whom routinely use such technology to conduct surveys of constituent memberships. However, the USDA has, to its credit, deployed formal review of some features of the NASS, including the National Research Council’s analysis of the USDA’s Agricultural Resource Management Survey (ARMS) (NRC, 2008). The ARMS, in particular, has been called...“the mirror in which American

farming views itself” (Economic Research Service, 2007) and is instructive relative to the changing structure of U.S. production agriculture, food safety, farm program participation levels, and farm household behavior...important classificatory findings.

Child Labor within U. S. Agricultural Worksites.

NIOSH has traditionally used grouped 5-year age cohorts for children and youth. And, comparable data is routinely published by both the Centers for Disease Prevention and Control and the World Health Organization. However, NIOSH is encouraged to re-consider 5-year cohort age aggregations in as much as failure to do so may doom intervention and policy initiatives within the U.S. across time...as appears to have happened with the DOL’s proposed revisions of hazardous orders affecting children working as hired laborers on U.S. farms (Federal Register, August, 2011).

NIOSH findings are extensively used within the DOL discussion of its proposed revisions of child labor hazardous orders (Federal Register. 2011). New, unpublished findings are cited, as well as earlier, published NIOSH recommendations for changes to hazardous orders (NIOSH. 2002). Also cited and discussed are findings of the BLS Census of Fatal Occupational Injuries for fatalities within the AFF sector involving persons less than age 18. However, NIOSH has not reported corresponding findings for non-fatal occupational injuries among persons less than age 18 in the AFF sector. However, the DOL discussion did include NIOSH findings from the Child Agricultural Injury Survey (CAIS) for persons under age 16 working on farms. In a separate exhibit to the DOL discussion, additional findings provided by NIOSH from the CAIS are reported, but aggregated for persons under age 20, termed “youth” (NIOSH. 2011a). This latter report regarding youth is not congruent with fact that child labor regulations pertain to persons less than 18 years of age (legal minors). Moreover, an additional challenge regarding use of the CAIS is that it does not survey labor aggregators, such as farm labor contractors. To illustrate the size of this latter sector, NASS finds in its quarterly survey of farms for July 10-16, 2011, direct-hire employment by farmers and ranchers was 836,000 while on-farm employment by labor aggregators was 350,000, or 30% of the overall total of hired farm workers (USDA NASS. 2011).

The misunderstanding regarding “child labor” – Federal regulation of child labor pertains exclusively to persons under age 18 – and NIOSH’s use of the term “youth” – persons under age 20 – is also perpetuated on the NIOSH website (NIOSH. 2011b). Under the NIOSH webpage “Childhood Agricultural Injury Prevention,” a MMWR publication is highlighted which finds a “...56% decline in youth farm injury rates from 1998 to 2009 (National Institute for Occupational Safety and Health, unpublished data, 2011).” Once again, the data refer to persons under age 20, not to persons under age 18.

The grouping of children below the age of 18 into one 15-19 age cohort ignores specific work practice reality at the agricultural or forestry worksite and tends to obfuscate the true situation for children exposed to worksite risk. The DOL’s discussion of its proposals quoted extensively from findings of a thorough U.S. General Accounting Office review of the subject (GAO. 1998). The GAO report pointed to disparities in child labor regulations for agriculture as compared with non-agricultural industries: “...a 13-year-old may not, under federal law, be employed to perform clerical work in an office, but may be employed to pick strawberries in a field. A 16-year-old may not operate a power saw in a shop or a forklift in a warehouse but may operate either on a farm.” (p. 30, GAO, 1998).

Grouping of 15-19 year old youth may have unintentionally provided a cognitive escape for organizations intent upon thwarting contemporary regulation of child exposures to agricultural or forestry worksite risk. Children aged 15-17 are children under the Fair Labor Standards Act (DOL, 1984), including compliance with hazardous orders; under the same act, youth aged 18 and above possess different worksite protection. This is vitally important when identifying the population at risk...the vast majority (75%) of children working in agriculture today are hired laborers, only 25% are self-employed

and unpaid (theoretically) family workers (GAO, 1998). Hence, going forward, NIOSH is encouraged to (1) amplify public understanding of who is vulnerable and stratify its data pertaining to children into at least two strata: those employed within agricultural enterprises, and those self-employed and other unpaid family workers contributing effort within agricultural enterprises, (2) improve the validity of the CAIS by extending the sample to include labor aggregators (termed “agricultural services” in the NASS survey published as *Farm Labor*), which sample frame is already developed and in use by NASS, and (3) explore the feasibility of collaborating again with DOL’s NAWS to initiate a survey of children who work as hired farm workers on crop farms. Taken together, these recommendations may result in discovery of different, yet important risk factors for preventable injury, disease, and disabling conditions among child cohorts exposed to agricultural or forestry worksite risk.

Hired Workers within U.S. Agricultural Worksites.

In association with the recommendations above, NIOSH is encouraged to expand the scope of knowledge concerning hired farm worker risk for occupational injury and illness. Monitoring changes in the population at risk is important for targeting appropriate interventions that may reduce hazards, injuries, and illnesses related to work. The AFF working population has been undergoing significant change over the past decade. For example, hired workers are increasingly involved in types of agriculture such as dairy farming for which they are not trained. The percentage of workers in agriculture who are hired rather than owner/operators has increased dramatically in recent years. These changes have implications for the need to develop surveillance systems that include hired workers to a greater extent than has been the case in the past. Hired workers may be recent immigrants, H2A workers, or seasonal workers who come from other countries. Continuous review of the working population is needed to adapt research and interventions to the characteristics of the workforce. For example, education and intervention initiatives are newly challenged by the increased migration of workers from Mexican and Central American villages where pre-Columbian, indigenous languages are spoken. This segment of the work force is estimated to number at least 200,000 in California agriculture alone (Mines et al. 2010). The native tongues of nearly all of these workers do not include English or Spanish, and present serious knowledge translation issues.

NIOSH is commended for its successful NIOSH-NAWS collaboration that yielded the first-ever nationally representative surveillance of hired crop workers that yielded useful information of occupational health status as well as exposures and risks to occupational injury and illness (NIOSH, 2009). In order to assist targeting of risk-reduction interventions, NIOSH is encouraged to further explore the variability of occupational injury risk with the size of hired farm worker employment per farm (see further discussion below). This is feasible because the NAWS surveillance is the *only* source that also provides nationally representative information about the number of workers on each farm in the sample. Otherwise inaccessible information about the occupational health status of workers on farms with fewer than eleven employees has been shown to be feasible and could readily be obtained. Finally, the committee encourages a NIOSH-NAWS collaboration to undertake a pilot survey of hired workers on livestock farms where an estimated 429,000 persons are employed (Martin, 2011). There is presently no nationally representative surveillance of hired livestock worker occupational health status and risk (It is now well established that hired worker employment on U.S. dairy farms is at least 139,000 and increasing with each passing year (Rosson et al. 2009)).

Approaching the ‘size dilemma’ in Agricultural and Forestry Enterprises

The organizational patterns and size of agricultural and forestry enterprises is so complex, depending on production system, region, and operational worksite conditions, that context should be identified in analyses and reports, whether authored by NIOSH or its external centers. The context for these endeavors is paramount, if only to ensure that findings are appropriately targeted in the future

toward the correct occupational cohort(s). Federal legislative language that uses terms such as “family farm” or “moderately-sized timber harvesting operations” is somewhat limiting, as is “...legislative language requiring...” or other terminology given that a legislative context from 1990-1992 or 1996 for agriculture, and the 1960’s for forestry is interesting, but out of touch with contemporary reality. And, such language is confusing in terms of occupational exposures. When describing surveillance activity, NIOSH and its extramural agricultural health and safety centers are encouraged to construct information that indicates (1) what agricultural or forestry enterprise is targeted, and (2) known operational worksite characteristics of that enterprise or cohort of enterprises. Other useful descriptors flow from both, and could include identification of (3) specific human cohorts presumed at risk of occupational exposure, (4) occupational exposures assessed, and (5) implications for other worker cohorts. As a result of such practice, it might be appropriate for NIOSH or the centers to target, for example, highly specialized enterprises, small enterprises, multiple-operator enterprises, or limited-resource enterprises. Each enterprise type may not possess a dominant role within the sector, but may contain exposures of keen clinical interest given specific climatic exposure (high altitude forestry logging), operational exposure (manual vs. machine tasking, or low-tech versus high-tech), knowledge/technology diffusion and adoption rate(s) by specific enterprise (use of precision guidance technologies or product harvest machinery), or in-migrant worker disease latencies, as defined by country of origin.

Defining AgFF Populations at Risk of Worksite Exposure

The review panel, operating from known characteristics of the AgFF sector workforce (NRC & IOM, 2008, p. 141) that make defining populations a complex issue, identified observations for consideration by NIOSH, the national children’s center, and regional agricultural health and safety centers which are summarized by its chairperson below:

- Work on further developing concise definitions of populations at occupational exposure risk. This is an essential task that will assist NIOSH in discharging its mandated responsibility. Competent surveillance, basic and applied research, intervention program targeting, and evaluation of intermediate and long-term program outcomes will be enhanced. NIOSH is in a good position to exercise further leadership here, given its important convening, coordinating and funding roles.
- Profile definitions by specific AgFF commodity specialization (shell fish, fish farm product, crab, cereal crops, oil crops, livestock (by type), timber, seed cone, horticultural crops, or nursery stock). This is helpful given that the associated occupational exposures are so complex and varied. Major movement toward such specialization has occurred since 1990 in each of the three economic areas comprising the AgFF sector (Hoppe & Banker, 2006; Garland, 2007; USCG, 2010).
- Develop definitions by demographic factors such as climate or geographic location, language, age, or gender in as much as AgFF owner/managers routinely engage in or assign different types of work employing such criteria.
- Develop definitions by work organization pattern. For example, contract workers in the agricultural, fishing, and forestry industries engage in occupational tasks that are organized differently by owners/managers than those experienced by non-contract workers. And, hired AgFF workers are assigned tasks in worksite settings that family and other non-paid workers may not undertake. Such specialization of tasking may also be closely related to part time versus full time work status, as well as skill level and prior work experience.

For agricultural enterprises, attention is recommended toward the following:

- Develop definitions that differentiate between worksite tasks based on “conventional” enterprises versus “organic” or even “natural” enterprises. Such differentiation may have to be used in the future in as much as “organic” and “natural” may function as surrogates for high-value crops that can generate large sales per hectare, but require substantially more human labor and effort to produce and market than enterprises such as conventional beef, poultry, or cereal crops. And, these worksites are growing in number as U.S. consumers express food preferences. These worksites use technology, however it may be different (sometimes smaller, occasionally larger) in scale, may employ different engineered tool components from that of conventional enterprises, or may use technology of dated design/manufacture.
- Develop definitions in agriculture that account for differences in knowledge of and use of emerging technologies such as precision agriculture or genetically modified seed will be important going into the future. Diffusion of such technologies changes the nature of the worksite since machines perform tasks here-to-for performed by manual labor, or introduce other unforeseen risk associated only with the type of technology involved. For example, diffusion of automated global positioning systems for steering tractor, crop protection product applicator, or grain harvesters (combines) appears to have resulted in lengthening the work day for agricultural workers, as sheer levels of physical fatigue formerly associated with manual steering guidance of agricultural machines are no longer an issue. And, use of genetically modified seed alters tillage employed upon agricultural terrain as well as crop protection product usage. Such decision-making changes risk of worksite injury and illnesses given known dose-response characteristics within agricultural worksites (Gerberich, et al., 1991).
- One of the most striking discoveries about American agriculture is the advancing age of principal farm operators compared with other U.S. self-employed workers. Improved health and introduction of new production technologies provide for long-term occupational activity well beyond conventional retirement age for most other U.S. workers (Mishra, et al., 2005) Over 27 percent of agricultural producers are aged 65 and over, versus 7 percent of other self-employed workers in nonagricultural industries (Hoppe & Banker, 2006). Such occupational longevity provides ample opportunity for development of a rich body of literature pertaining to occupational exposure risk and outcomes that may presage other U.S. worker futures in the “emerging” world economy of the 21st century. NIOSH and its centers should consider championing this body of research. And, this increasing longevity is producing an ever-increasing cohort of vulnerable aging workers in both small individually owned worksites and large business agricultural operations.
- And, a note of caution: The USDA organizes its analysis and characterization of U.S. agriculture following Boehlje (1992, p. 219) who defines the structure of an industry or sector – including the U.S. agricultural sector – along five dimensions:
 - size/distribution
 - technology & production characteristics
 - characteristics of the workforce (both managers/entrepreneurs & employees)
 - Ownership and financing pattern (tenancy, leasing, debt/equity sources, etc.)
 - Inter- and intra-sector linkages (vertical or horizontal integration, etc.)
 However, when defining worksite exposed populations at risk of occupational disease, disabling conditions, or injury, such structural definitions may need to be used with caution when constructing sampling frames in order to avoid (1) potential distortion of useful human exposure descriptions, and (2) introduction of response bias.

Use of Fotonovela with Spanish (or other non-English) Speaking Populations

The use of fotonovela (and other related printed facts sheets, etc.) appears to be spreading within the AgFF sector when r2p or other dissemination activity occurs. Their origin is anchored within Hollywood and European movie production companies who desired to increase the life of classic movies in the Southern hemisphere in the 1950's and later. Meanwhile, public health agencies developed such media to address culturally sensitive issues such as sexually transmitted disease, use of infectious disease preventive devices, and birth control. The panel's concern is anchored on the observation that (1) fotonovela appear to be a dying visual medium as they had largely vanished from the Southern Cone of Latin America by the late 1970's, (2) the demography of resident or in-migrant populations at risk has changed, and (3) there are no current evaluations about its use in the public health arena within Latin American or the Northern Hemisphere. Other more contemporary and potentially useful media need to be developed by resourceful agencies conducting intervention activity within the sector. therefore NIOSH or its agricultural health and safety centers might consider initiating such activity.

Printed Media Development

Much more printed outreach material and training items for use with non-English speaking agricultural and forestry workers has emerged across time. However, printed materials may be useless to communicate with the large and increasing size of indigenous migrant workers from southern Mexican and Central American villages where pre-Columbian languages are the norm; a great many of these workers are neither fluent nor literate in either Spanish or English. As these materials are typically developed by NIOSH's extramural centers, it may be propitious that such material, as a minimum, be subjected to focus group evaluation so that imagery and linguistic styles are assessed and adapted for AgFF multi-lingual and racial worksites.

Emerging Animal Agriculture Production Practices...Opportunity for Engagement

Attention by NIOSH and its agricultural health and safety centers is encouraged toward four different developments occurring within the nation's animal agricultural sector: changing dynamics of the U.S. livestock and poultry industries, continued use by AgFF workers of injectable, pour-on, and feed additive antimicrobial products, emerging zoonoses, and new exposures within emerging livestock and poultry production systems. Since the last AgFF Program evaluation, agricultural livestock and poultry industries have experienced substantial consolidation. Additionally, regionalization of the swine, poultry, and dairy industries has approached maturity, as the swine industry is now primarily located in the upper Midwest and in North Carolina, the poultry industry in southeastern U.S. states, and the dairy industry in the upper Midwest, California, Oklahoma, eastern New Mexico, and the Texas Panhandle regions (NRC, 2012). The programmatic implications for NIOSH's regional centers are enormous as research, education, and outreach portfolios will likely have to adapt to these regional developments.

The agricultural livestock industry, and land-grant institutions have typically indicated that human exposure associated with use of pharmaceutical products within swine, poultry, beef (including feedlot and cow-calf operations), horse, and dairy enterprises is a low-risk issue largely confined to veterinarians since...all products are allegedly used by a veterinarian or under his/her direct supervision. This observation is fundamentally false when operationalized to the livestock farm site, since in worksite practice, much use occurs by owners/managers and/or workers without prior consultation with veterinarians. And, some products, such as antimicrobials used as growth promoters in livestock feed are employed in large quantities and routinely handled

by workers as these products are poured into feed mixing tanks for blending with other feedstuffs, subsequently dumped into mixing wagons or bulk feeding trucks, and then dispensed into bunks, mangers, troughs, feed alleys, or hay feeders. Potential for human ingestion, dermatological contamination, and non-target injection are associated with use of veterinary pharmaceutical products, hence assessment of these exposures as they are identified will be important.

Zoonotic infection among agricultural and forestry workers is not new and is indigenous to all agricultural and forestry regions of the U.S. Since 1980, over 75 percent of new emerging human infectious diseases world-wide have been vector-borne or zoonotic, and over 60 percent of all infectious disease found world-wide in humans are caused by multi-host pathogens that are recognized for their ability to move across species lines (Center for Food Security and Public Health, 2010). Among the factors that lead to zoonotic disease emergence and reemergence are climate change, globalization of travel, trade, and movement of working-age populations (including returning U.S. service personal from overseas conflicts), interspecies transfer of pathogens, environmental degradation, human and domestic animal encroachment into wildlife habitat that may result in part from U.S. urban/suburban population growth, increased concentrations of food-producing animals (including feedlots and intensive aquaculture), and bioterrorism. Some of these factors are not amenable to human intercept, however others such as environmental degradation, globalization, encroachment, and production practices that lead to increased livestock concentrations are. And, agricultural and forestry workers are the veritable “canary in the mineshaft” when zoonotic disease outbreaks occur, given their proximity to animal and avian hosts. In light of this risk, NIOSH is encouraged to (1) liaison (or partner) with the World Organization for Animal Health (OIE), the International Plant Protection Convention (IPPC), and the CODEX Alimentarius Commission (Codex) for purposes of monitoring the occurrence and course of epizootics that could endanger human AgFF sector workers, (2) encourage targeted surveillance of emerging zoonosis among livestock workers (see, for example, Withers, et al., 2002; Kase, et al., 2007), and (3) incentivize the regional agriculture centers to establish liaison with their respective state Departments of Agriculture who house state boards of animal health (state veterinarian offices) since they shoulder much of the responsibility in the U.S. for tracking occurrence and spread of zoonotic disease. Public-private sector partnerships are emerging involving the extramural agricultural health and safety centers that have birthed laboratory and other analytic capability for exploring zoonotic disease outbreaks in human working populations. Moving beyond identification to containment and prevention suggests that NIOSH and its regional centers begin the process of identifying worksite practice(s) that could reduce or eliminate known sources of zoonotic disease, while also encouraging analysis into zoonotic workforce risk. Further, r2p or other outreach program development could occur.

U.S. public perception about the manner in which domestic livestock are born, raised, and euthanized has pushed American agriculture toward use of alternative methods for animal production. Such methods include new facility designs, machinery modifications, change in livestock handling practices, and development of new risk avoidance schemes. Recent developments include, for example, moving away from caged hen layers toward “group” chicken pens, from “growout” housing for meat-based poultry, turkeys, and ducks to “free-range” housing, and from individual swine gestation crates to gestation pens. These developments are not neutral toward worker health, nor toward zoonosis, food pathogens, water contamination, or environmental degradation. For example, swine gestation pens create dangerous working conditions for swine enterprise employees since no barrier exists between the worker and several sows...a barrier typically provided by the metal structure of the individual gestation pen that housed one sow alone. Or, consider the movement from “growout” housing, where virtually no option exists for flock infection from pathogenic forms of influenza, to free-range grazing/housing where, as suggested by disease investigation in Asian countries, a strong

association existed between H5N1 virus and abundance of free-grazing ducks, native chickens, cocks, wetland, and humans (Gilbert, et al., 2006). And, free-range housing places fowl and agricultural workers at the mercy of climate extremes, unlike that of a “growout” house. Other developments are certain to emerge in the future, therefore NIOSH’s regional agricultural health and safety centers should monitor the emergence of and initiate worker-impact studies pertaining to these systems. Further, the national children’s center should monitor these developments closely and consider development of guidelines as children and youth may become involved in “choring” within such systems.

Forestry within the NIOSH AgFF Research Program

The modest involvement in this sector of all players within the AgFF Research Program has been noted above. Yet, this portion of the sector continues to experience disproportional levels of occupational injury and disease. NIOSH is commended for including forestry worksites within the purview of NORA-2, providing the nation with a roadmap going forward that should ultimately reduce the toll of occupational injury and disease within the sector. NIOSH is also commended for attempting to bring forestry expertise in-house as has happened with fishing. NIOSH is exhorted to continue that effort, in the hope that such expertise can be added through any available Federal staffing or contract mechanism.

Given the modest resource level currently assigned to this initiative, surveillance shall have to be targeted so that the most important work tasks and vulnerable workers of the estimated 160,000 people at risk are addressed across time. Fortunately, NIOSH possesses research program experience back to at least 1993 in this sector and is positioned to conduct research identifying determinants of injury and disease and the state-level variation of such across the nation. Additionally, two of its regional agricultural health and safety research and education centers also include work within the sector. NIOSH is encouraged to expand, in part, its future forestry worker surveillance focus from forest production entities to forest labor contractors/aggregators. Vast amounts of labor are provided by such firms for timber and other forest product harvest, tree marking and clearing, and fire suppression activity. Sampling frames for surveillance of such entities can be sought from the U.S. Department of Commerce, and state labor offices. Such surveillance is crucial to accurate characterization of the exposed workforce given that forestry services works are predominantly Hispanic, greenery and mushroom harvest workers are typically Asian, fire fighters are primarily American Indian or Hispanic, and localized forestry crews may be largely Russian or Eastern European of descent. Additionally, these workers routinely use insect repellent, equipment fuel and lubricants, paint and fuel/oil solvents, and herbicides that impact human health. Opportunity to explore health impacts and design of efficacious interventions abound, and NIOSH has already evidenced interest in exploring the benefit that accrues to forestry workers when wire rope is replaced with synthetic line.

While the effort to harden windscreen and side window glass to prevent broken metal blades of mechanized tree harvesters from penetrating cab structures and injuring or killing forestry workers was not led by NIOSH, nevertheless it was facilitated and advanced to an ISO standard in 2010. Such activity is an example of useful research effort that leads to design and manufacture change without federal regulation, rather through promulgation of an engineering standard. And, it stands as an example of what an entity such as NIOSH, perhaps working through partners that include standing forestry education and research centers typically housed within land grant universities, could complete across time. Accordingly, NIOSH is encouraged to seek out partners from established forestry research and education entities for such useful endeavors, in part because existing state-level resources may be effectively matched with modest federal resources, thereby achieving what neither could accomplish alone. Alternatively, NIOSH could be the convener of researchers from its established regional research and education centers and land-grant university forestry departments so that complementary effort might be pursued.

Fishing within the NIOSH AgFF Research Program

NIOSH's long tradition of using public health approaches for addressing occupational injury and disease in this sector has continued. And regional AgFF centers such as the Pacific Northwest Center (PNASH) and the Southwest Center (SCAHIPE) have initiated both surveillance and intervention activities within their respective off-shore waters. The program of surveillance, research, assessment, intervention and education, development of policy, and conduct of evaluations effectively positions NIOSH to conduct a most successful program. Not surprisingly, progress in reduction of injuries has occurred, resulting from AgFF Research Program investments, movement of successful intervention strategies to other U.S. coastal waters along the West, Gulf, and Eastern seaboard, Coast Guard engagement, improvements in vessel safety, full engagement of both public and private stakeholders, use of PPE at the fishing worksite, and worksite procedural change, including fishing management regimes. Still, opportunity for improvement exists, perhaps most notably in collaboration with NIOSH regional AgFF research and education centers. NIOSH is encouraged to exert continued leadership, particularly in using its surveillance capability to identify worksite targets for research and intervention, including domestic in-land and coastal fish farms, as well as assist in bringing affected stakeholders to the table. Additionally, NIOSH may wish to explore the following:

- Synthetic line use and replacement. The forestry industry is evaluating use of synthetic line as a replacement for wire rope and associated mechanical issues such as breakage and wear while in use. Both the fishing and forestry areas may be able to collaborate in this area given that injuries to workers occur when wire rope fails under load.
- Musculoskeletal injury. Surveillance of such injuries may provide insight about vessel-related injury resulting from exposure on gillnetters and/or larger trawlers or crabbing vessels.
- Confined space. Like agriculture, fishing products are stored within confined space, and other space is allocated to powered equipment that may emit harmful gasses. Worksite on-vessel awareness and educational interventions, including use of appropriate PPE, might be developed to address the hazard should engineering interventions prove unfeasible.
- Work/task duration. This issue is common to the entire AgFF sector, though duration of the fishing work day and impact awareness, while addressed by the U.S. Coast Guard, remains an intractable issue. NIOSH possesses an enviable intervention and educational image within the fishing industry and may be able to launch, in partnership with affected stakeholders, efficacious, yet novel task design.

Climate Change Impact and U.S. AgFF Workers

Though the U.S. public is not of one kindred mind, and current observational and interpretive capabilities are inadequate to fully understand and address future scopes and rates of change, there is robust scientific consensus that climate change is occurring (Astill, 2012; Tackle, 2012; ILO, 2011; Chu, 2009; National Science and Technology Council, 2008). The potential impact upon U.S. production agriculture is largely uncharted, however recognition of change has occasioned a proliferation of scientific studies that have concluded the U.S. must move convincingly in the next decade to prevent carbon lock-in (Burney, 2010; Paarlberg, 2009; California Environmental Associates, 2007; Snyder, et al., 2007; Tilman, et al., 2002). Agriculture shall have to play a role, potentially occasioning land use alteration, introduction of new cultivars, management of water resources, and change in all or most management regimes currently deployed to direct agricultural input and process resources, including agricultural labor.

Climate change is impacting ecosystems and services...these impacts may accelerate well into the future given that these interactions are complex. Important changes in regional and super-regional ambient temperatures, precipitation patterns, insect outbreaks, severe storms, and drought across the

southern and southwestern regions of the U.S. could result in ecosystems that experience excessive oscillations which fracture conventional species relationships such as pollinator/plant or predator/prey behaviors, and oscillate out, ultimately cascading upon human populations, including agricultural labor. These change agents create systems dynamics that do not represent simple causal relationships; these relationships pose complexity for scientists and clinicians who seek to mitigate risk factors and treat agricultural workers who suffer from, for example, in-migrant arthropod bites and stings, dermatological reaction to invasive plant species, and thermal exposures.

Other exposures are certain to emerge, because climate change has brought (1) longer growing seasons resulting in more exposure time for workers performing agricultural tasks, (2) wetter springs so producers are using larger and more complex machinery and compression of work periods to plant crops in shorter times and within wetter soil, resulting in changes in exposure and dose-response relationships for agricultural workers, (3) more summer rain allowing crop cultivation at higher altitudes, thereby expanding U.S. cultivated agricultural acreage unto rangeland or pasture which in turn changes the worksite exposures of agricultural workers, (4) fewer long hot spells in northern crop latitudes providing producers with options to place plants closer together so there are fewer pollination failures...leading to use of precision planting technologies that require a highly trained agricultural workforce, (5) higher summer humidity across most crop growing regions of the U.S. that leads to more use of crop antimicrobials and artificial forced drying of harvested crops which, in-turn, brings more worker exposure to both crop protection products and grain/crop drying and storage technologies, (6) drier falls that lead to later harvest and expanded use of large-capacity field crop harvest technology, resulting in another change in technologies workers use, and (7) new varieties of insect and cereal pests necessitating altered agricultural practices and worker protection..

Accordingly, in response to climate change, NIOSH may wish to convene a “roundtable” or a special plenary session at a signature agricultural health and safety event for which it has absorbed sponsorship obligations. Such a venue would draw upon world-class clinical and scientific expertise in order to explore potential worker health outcomes and preparation, given these pending changes, of tomorrow’s class of agricultural health and safety experts.

Five-Year Review Summary

The panel’s chair transmits the *Five-Year Review Panel’s* complement of NIOSH’s AgFF Research Program for taking a major leadership role in convening key stakeholders to address issues of occupational health and safety, followed by implementation of surveillance and research agendas that respond to identified need. The program has over time developed and deployed innovative complementary regional centers, a national children’s center, and its own intramural activity en-route to attempting to identify and redress occupational health and safety issues in the AgFF sector. Additionally, the program has developed, in consort with key stakeholders, a signature national occupational research agenda for the sector. Challenges remain, given (1) resource constraints across time since the AgFF portion of the NIOSH budget provided by Congress is relatively small versus the gross domestic product (GDP) of the affected sector, (2) evolving global and U.S. public policy, and (3) change in worksite exposures resulting from introduction of new worker organization and deployment patterns, field and plant technologies, and climate change.

Within the context of these challenges, the AgFF Research Program merits, when using the NASS-BANR evaluation framework, a score of “5” for relevance, and a score of “4” for impact.

NIOSH has demonstrated its ability to focus on some of the most outstanding issues and to initiate efficacious actions. Given the diverse nature of American agriculture, forestry, and fishing endeavor, and the multiple issues that emerge as the sector continues to evolve, the AgFF research program has provided an extensive mosaic that is addressing many of the outstanding issues in the production areas of the sector. The program has implemented basic and applied research in high priority areas responsive to current and some future AgFF worksite developments. The program has also been instrumental in developing a national occupational research agenda for the sector, cultivating strategic partnerships, and moving program activity forward toward r2p outcomes. The AgFF Research Program has contributed data and information leading to design and implementation of major childhood agricultural injury interventions, fishing vessel injury interventions, rollover protection structures for agricultural field equipment, PPE devices, and forest logging equipment re-design. NIOSH and its extramural centers did respond to the BANR 2006-2007 review with appropriate dispatch and deployed vigorous corrective action.

The AgFF research program has the capacity to conduct research and initiate programs necessary to protect those exposed to worksite risk within the sector. The program, and its leadership within NIOSH, represents not only an undertaking of major human importance, but also a major underpinning of the kind of effective workforce that American agriculture, forestry, and fishing requires. In the final analysis, a healthy, safe, vibrant, and thriving workforce serves the nation's most fundamental interest since such a workforce contributes substantially to the productivity of the agricultural, forestry, and fishing industries comprising the overall sector.

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a.) Table 40. Farms by Concentration of Market Value of Agricultural Products Sold: 2007

- b.) Table 2. Market Value of Agricultural Products Sold Including Landlord's Share and Direct Sales: 2007 and 2002

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APPENDIX A

AgFF Five-Year Review Panel Charge

BACKGROUND and STATEMENT OF RE-REVIEW TASK: The Office of the Director, The National Institute for Occupational Safety and Health desires an evaluation of the contribution to reductions in workplace hazardous exposures, illnesses, or injuries of the Agriculture, Forestry, and Fishing Research Program. This review will address the program's impact and relevance to health and safety issues within workplaces found in the overall sector.

CHARGE TO THE PANEL: The National Institute for Occupational Safety and Health has requested that a panel be convened to undertake a re-review of its Agriculture, Forestry, and Fishing Research Program (AgFF Program).

Specifically, the Re-review Panel has been asked to review and assess the AgFF program's performance since 2006 and...

- provide an integer score (whole number) of its *impact*, and
- provide an integer score (whole number) of its *relevance*.

En-route, the Re-review Panel may wish to make recommendations for improvement, including ...

- identifying research opportunities, and
- recommending program priorities for future deployment.

The Re-review Panel will employ the scale listed on page 159 (Box 10-1) of the National Academy of Science's (NAS) report "*Agriculture, Forestry, and Fishing Research at NIOSH – Reviews of Research Programs of the National Institute for Occupational Safety and Health*" when evaluating the AgFF program for impact, and will employ the scale listed on page 161 (Box 10-2) of the same report when evaluating the AgFF program for relevance. A more detailed review of these scales is embedded within the National Academy's report entitled "*Evaluating Occupational Health and Safety Research Programs: Framework and Next Steps*", pages 64-69.

The panel's chair will assemble all scoring sheets and construct a mean of the distribution of scores. That mean will then be converted to a whole integer. The Re-review Panel will be using, as background information, NIOSH program logic models that are identified and described on pages 27-28, and 39 of the NAS report entitled "*Evaluating Occupational Health and Safety Research Programs: Framework and Next Steps*". Specifically, the Re-review Panel may wish to review the *AgFF NAS* report- pages 49-68, 70-71 (Surveillance Logic Submodel), pages 81-82 (High-priority Populations at Risk Logic Submodel), pages 95-96 (Health Effects Research Logic Submodel). Pages 112-113 (Intervention Research Logic Submodel), and pages 124-127 (Outreach Logic Submodel).

Appendix B

Agenda

**Panel to Assess Performance of the NIOSH Agriculture,
Forestry, and Fishing Research Program from 2006 – Present**

**Meeting in Session
May 30-31, and June 01, 2012
NIOSH Office Suite
Patriots Plaza 1, Suite 9000
Washington, DC**

**WEDNESDAY, May 30, 2012
Suite 9000**

CLOSED SESSION (Panel and staff only)

8:30 – 8:45 a.m.	Introductory Remarks and Brief Introductions	<i>Paul Gunderson, Chair</i>
8:45-10:00	Overview of Panel Task, Charge, and Scoring	<i>Paul Gunderson, Chair</i>
10:00-10:15	Break	

OPEN SESSION

10:15	Welcome	<i>John Piacentino</i>
10:25	NIOSH Program Overview	<i>John Howard</i>
10:40	NIOSH AgFF Research Program Review	<i>George Conway</i>
11:10	Agriculture Safety and Health Council of America	<i>William Nelson</i>
11:30	National Children's Center for Rural and Agricultural Health and Safety	<i>Barbara Lee</i>
12:00-1:00 p.m.	Lunch	
1:00	Children in Agriculture	<i>Dawn Castillo</i>
1:20	NIOSH Division of Surveillance Hazard Evaluations and Field Studies	<i>Geoff Calvert</i>
1:50	NIOSH Division of Safety Research, Surveillance	<i>John Myers</i>

2:10	NIOSH Division of Safety Research, Overview	<i>Dawn Castillo</i>
2:25	Pacific Northwest Agricultural Safety and Health Center	<i>Richard Fenske</i>
2:40-2:55	Break	
2:55	Budget, Administration, and Earmark	<i>Kelley Durst</i>
3:10	NORA and Forestry	<i>Brad Husberg</i>
3:25	NIOSH Education and Information Division	<i>Kathleen MacMahon</i>
3:40	NIOSH Alaska Pacific Office	<i>Jennifer Lincoln Ted Teske Chelsea Woodward</i>
4:30	Adjourn	
5:30	Panel Dinner	

**Thursday, May 31, 2012
Suite 9000**

Open Session

8:00 a.m.	Welcome and Introductions	<i>Paul Gunderson</i>
8:10	Great Plains Center for Agricultural Health	<i>Fred Gerr</i>
8:30	NIOSH Division of Applied Research and Technology	<i>Gayle DeBord</i>
8:45	Western Center for Agricultural Health and Safety	<i>Steve McCurdy</i>
9:00	Southeast Center for Agricultural Health and Injury Prevention	<i>Teresa Donovan</i>
9:15	Moving Farm Workers, NIOSH Technical Assistance	<i>Tony McKenzie</i>
9:25	Southwest Center for Agricultural Health, Injury Prevention and Education	<i>Tim Struttman</i>
9:45-10:00	Break	
10:00	High Plains Intermountain Center for Agriculture Health and Safety	<i>Stephen Reynolds</i>
10:15	E Coli Outbreak at a Correctional Facility	<i>Stephen Reynolds</i>
10:25	Agriculture Center Directors Coordinating Committee	<i>Stephen Reynolds</i>
10:35	NIOSH USDA Collaboration	<i>Allison Tepper</i>
10:50	NIOSH Office of Extramural Programs	<i>Allen Robison</i>
11:20	NIOSH National Personal Protective Technology Laboratory	<i>Roland BerryAnn</i>
11:30	Pesticide PPE	<i>Kim Faulkner</i>

11:50 a.m. -1:00 p.m.	Lunch	
1:00	Division of Respiratory Disease Studies	<i>Ainsley Weston</i>
1:15	Northeast Center for Agricultural Safety and Health	<i>John May</i>
1:30	Social Marketing Overview	<i>Julie Sorensen</i>
1:45	Social Marketing of Tractor Roll Over Protection	<i>John May</i>
2:10	Closing Remarks Q&A	<i>George Conway</i> <i>Brad Husberg</i>
3:00-3:15	Break	

Closed Session (Panel and staff only)

3:15-4:15	Recap of Past 1.75 days Review panel's approach to scoring for program impact and relevance and discuss information presented by AgFF program staff, Ag Center staff, etc.
4:30-5:00	Discuss Letter Report Draft Outline Panel to provide suggestions to Chairperson about information to include in Letter Report
5:00-5:30	Panel Discussion
5:30	Adjourn

(Evening Dinner on Your Own)

**Friday, June 01, 2012
Suite 9000**

CLOSED SESSION

8:00-12:00	Panel Deliberations
12:00	Adjourn

Appendix C

Biographical Sketches of Panel Members

Paul D. Gunderson (*Chair*) is currently director of the Dakota Precision Agriculture Center located at Lake Region State College, Devils Lake, N.D. He is the former director of the National Farm Medicine Center (1992-1996) and former director of the Marshfield Clinic's Medical Research and Education Foundation (1993-2000) both in Marshfield, Wisconsin. In each of these capacities, he has conducted numerous research initiatives exploring the health effects of agricultural exposures, convened scientific meetings and seminars including chair of the first Board on Agriculture and Natural Resources (BANR) review of the NIOSH AgFF Research Program in 2006-2007, and more recently chair of the International Labour Organization's Meeting of Experts on Safety and Health in Agriculture that drafted *Safety and Health in Agriculture – A Code of Practice*, chaired scientific review mechanisms for the National Cancer Institute and the Centers for Disease Control and Prevention, and testified before Congress about the need for a national agenda on agricultural health and safety. His career exploring the health impact of human activity in agricultural work settings began in 1976 with research on the respiratory effort of working in upper Midwest poultry barns and continued through his initial retirement in 2000. Upon discovering retirement did not suit his lifestyle, he return to academe, after having served in the 1980's and 1990's as an adjunct professor in public health administration at the University of Minnesota's School of Public Health, and in the Health Services Management and Administration Program of St. Mary's University, Winona, Minnesota. He is currently exploring the reach and impact of precision agricultural technologies upon U.S. and Canadian agriculture. He has published over 100 papers in scientific journals, is on the editorial board of several, and sits on boards of both private and public agencies. He chaired the initial Review Committee that evaluated the AgFF research program within NIOSH during 2006 & 2007. Dr. Gunderson received his PhD in education from the University of Minnesota, his MA in industrial technology from Ball State University, and his BS in both English and industrial technology from Moorhead State College, Minnesota.

Thomas L. Bean is Professor and Chair Emeritus of the Department of Food, Agricultural and Biological Engineering (FABE) at the Ohio State University (OSU). He served over 20 years (1989-2010) on the faculty and discharged three terms (9 years) as chair of the FABE department. Throughout his career Dr. Bean engaged in teaching, extension and research. As both faculty member and chair, he maintained his academic commitment to his discipline, agricultural safety and health. He has published over 100 journal articles, papers, fact sheets and other publications. In addition, he has received and successfully completed numerous grants from NIOSH, OSHA, CPSC, USDA and state agencies. He has received 13 university and professional society awards for his efforts. The first 13 years of his professional career (1976-1989), prior to moving to OSU, were spent as a faculty member at West Virginia University (WVU) with a primary role within the WVU Extension Service. He received his degrees at the University of Nevada and WVU.

Maria T. Correa is associate professor of epidemiology and public health in the College of Veterinary Medicine at North Carolina State University. Dr. Correa is the university's Concentration Leader in population medicine and veterinary public health, a member of the College of Veterinary Medicine International Program, and the Hispanic Faculty Liaison to the Office of Institutional Equity and

Diversity, NCSU. She is a member of the American College of Epidemiology, the North Carolina Veterinary Medical Association, and the Phi Zeta Veterinary Honorary Society. Her research and outreach activities focus on the use of epidemiologic and anthropologic approaches when conducting surveillance of the prevalence of foreign-animal diseases, assessing the risk of transmission of foreign-animal diseases and zoonotic disease at the farm level, antecedents to bioterrorism and agro-terrorism agents, zoonotic disease etiology, and development of biosecurity measures at the farm level. She also conducts evaluations of target group knowledge of disease transmission and prevention, and identifies factors (use of alternative medicine, sociocultural understanding of disease, immigration status, and community isolation) that limit human population cohorts access to Western medicine or public health information. She served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007. Dr. Correa received her *Practicante de Veterinaria* (degree in veterinary sciences) from the State University of Uruguay and her MS.c. and Ph.D. in epidemiology from Cornell University.

James A. Dosman is director Emeritus of the Institute of Agricultural Rural and Environmental Health at the University of Saskatchewan, the only institution in Canada that provides research, education, and health promotion to agricultural and rural populations. He is a fellow of the Royal College of Physicians and Surgeons of Canada and a professor Emeritus in the Department of Medicine at the University of Saskatchewan. He is a founding chair of the Canadian Coalition for Agriculture Safety and Rural Health (1992), founding co-chair of the Canadian Rural Health Research Society (202), a past member of the Governing Council of the Medical Research Council of Canada (1995-2000), a past president of the Canadian Thoracic Society, and a current member of the Canadian Nuclear Safety Commission. He is an associate member of the Western College of Veterinary Medicine and of the Department of Community Health and Epidemiology at the University of Saskatchewan. Dr. Dosman's expertise includes respiratory diseases, occupational diseases, and agricultural medicine. Dr. Dosman has chaired or co-chaired six international symposia on health issues related to agriculture and rural populations, and was Scientific and Clinical Advisor to the International Labour Organization during its development of *Safety and Health in Agriculture – A Code of Practice*. He assisted in establishing the annual Agriculture Health and Safety Conference of Canada, the Canadian Agricultural Injury Surveillance Program, the Canadian Agriculture Safety Program, and the Agricultural Health and Safety Network that provides educational services, respiratory health and hearing screening programs, courses in emergency preparedness, and other educational opportunities to rural Canadian populations. He served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007. Dr. Dosman received his B.A., M.A., and M.D. from the University of Saskatchewan.

William A. Groves is associate professor of industrial health and safety and chair of the graduate program in industrial health and safety in the Department of Energy and Geo-Environmental Engineering of Pennsylvania State University. He is a Certified Industrial Hygienist (CIH) and a Certified Safety Professional (CSP), and holds membership within the American Industrial Hygiene Association (AIHA) Gas and Vapor Detection Systems Committee and Pennsylvania State University Outreach and Graduate Education Committee. He is a reviewer for a number of professional and scientific journals and the Royal Society of Chemistry. Dr. Grove's research is focused upon the development of sensors and instrumentation for measurement of organic vapors, exposure assessment methods and strategies, biologic monitoring, and design and effectiveness of personal protective equipment. He helped develop instrumentation based on Surface Acoustic Wave (SAW) sensors to measure organic vapors in breath and

air, and developed a sampling system for assessing respirator protection from ammonia in livestock production facilities. Dr. Groves was an assistant professor in the Department of Preventive Medicine and Environmental Health and co-director of the industrial hygiene core within the Great Plains Center for Agricultural Health, University of Iowa. His career includes functioning as an industrial hygienist and engineering loss-control specialist with Aetna Life and Casualty from 1986-1990, and an industrial hygienist at Newport News Shipbuilding from 1990-1991. He served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007. Dr. Groves received his Ph.D. and MPH in industrial health from the University of Michigan, his B.S. in chemical engineering from Case Western Reserve University, and his B.A. in natural sciences from Edinboro University.

Lurilla Lee is Trident Seafood Corporation's (Seattle, WA) Vice President of Vessel Safety for a diverse fleet of over 40 active fishing industry vessels, a role that involves ensuring vessels and crews meet regulatory requirements and are prepared for the unexpected. Trident Seafoods proactively sets and maintains high safety standards, often exceeding regulatory requirements, and is recognized as a leader in promoting a robust safety culture. Ms. Lee has served in the maritime community for over 29 years. Starting as an officer with the U.S. Coast Guard, she qualified as a shipboard engineering department officer, served as Commanding Officer of a remotely located Long Range Aid to Navigation Station, and later became a marine inspector enforcing federal and international safety and pollution regulations and conventions on various commercial vessels. As a civil servant with the Coast Guard she was one of the initial fishing vessel safety examiners hired when the Fishing Vessel Safety Act of 1988 came into effect, and later became the Fishing Vessel Safety Coordinator for (then) Marine Safety Office Puget Sound. There she worked with her counterparts to lay the ground work for fishing vessel safety in the Pacific Northwest and Alaska. She has spent the last 14 years with Trident Seafoods. She serves on the North Pacific Fishing Vessel Owners Association Board of Directors, on the Seattle Maritime Academy Technical Advisory Committee, and Fishing Vessel Alternate Director for Washington State Maritime Cooperative, an oil spill response incident management cooperative. Ms. Lee received her MS in General Chemistry from the University of Washington and her BS in Physical Science from the U. S. Coast Guard Academy. She retired from the Coast Guard Reserve with the rank of Captain (O-6).

James D. McGlothlin is associate professor of industrial hygiene and ergonomics and director of the Occupational and Environmental Health Sciences Graduate Program at Purdue University. He is a Certified Professional Ergonomist and is retired from NIOSH. He studies relationships between ergonomics, epidemiology and industrial hygiene in order to evaluate and control physical, chemical, and biological hazards in human occupational environments. Dr. McGlothlin develops and administers ergonomic program to prevent musculoskeletal injuries, promote health, and improve productivity and quality in the workplace. Most recently, he has worked on methods to integrate real-time sampling methods with videography, thereby developing more accurate worker risk assessment profile methods that lead to cost-effective controls. At NIOSH, he served as a senior researcher in ergonomics, an occupational and environmental safety and health specialist, an industrial hygienist, and chief of the Division of Safety Research. He served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007. Dr. McGlothlin received his Ph.D. in industrial health with a specialty in ergonomics from the University of Michigan-Ann Arbor. He holds an M.P.H. in epidemiology, an M.S. in environmental and industrial health, and a B.A. in industrial psychology from the University of Hawaii.

Susan H. Pollack is an assistant professor, holding joint appointments in the Department of Pediatrics located within the University of Kentucky- College of Medicine and the Department of Preventive Medicine within the College of Public Health, and is board-certified in pediatrics and occupational medicine. She directs the Pediatric and Adolescent Injury Prevention Program at the Kentucky Injury Prevention and Research Center. She is the principal investigator in the Injury Free Coalition for Kids of Lexington at Kentucky Children's Hospital and has been serving as the Kentucky State SAFE KIDS Coordinator, and assists the Kentucky State Department for Public Health in child-health and injury prevention activities, including support for injury epidemiology and prevention programs within county health departments. Her interests also include child-fatality review, emergency medical services for children, health and safety in child care and among incarcerated adolescents, and equestrian safety. Dr. Pollack has served in leadership positions within the American Academy of Pediatrics, and the National Committee on Violence, Injury and Poison Prevention. She served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007. Dr. Pollack received her A.B. in environmental biology and sociology from Smith College, her M.S. in physiology from Georgetown University, and her M.D. from Eastern Virginia Medical School.

Don Villarejo is cofounder of the California Institute for Rural Studies, which he served for 22 years as its executive director. His research interests include pest management, farm-labor contractors and safety in agricultural fields, farm-labor housing, health and well-being of California's hired farm works, healthcare for the working poor, methods for surveying farmworker populations, and land reclamation policy in the western states. In addition to his speaking engagements at agricultural health and safety seminars and conferences, Dr. Villarejo conducts training for attorneys and field staff of the Agricultural Labor Relations Board. He has received numerous honors, including the 2005 Advocate of Social Justice Award from the Ecological Farming Association for his long-term contributions to the well-being of people who work in food production and agriculture, and a Board of Directors Award from the Mexican American *Concilio* of Yolo County in California. He served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007. Dr. Villarejo received his B.S., M.S., and Ph.D., all in physics, from the University of Chicago.

James J. Zuiches recently retired (12/2011) as vice chancellor for Extension, Engagement, and Economic Development at North Carolina State University, including the Cooperative Extension Service, Industrial Extension Service, Small Business and Technology Development Center, noncredit programs of the Jane S. McKimmon Center for Extension and Continuing Education, the Economic Development Partnership, the General H. Hugh Shelton Leadership Center, and the outreach and public service programs of the colleges and other university programs. His research specialties include demography and population studies (specifically migration models and population change between urban-rural areas, and labor force dynamics), rural development, rural sociology, and research administration. He was a professor in community and rural sociology and project leader for the National Coalition for Rural Entrepreneurship at Washington State University, where he also served as dean of the College of Agriculture and Home Economics and director of Cooperative Extension and the Agricultural Research Center. Dr. Zuiches also served at Cornell University, Michigan State University, the National Science Foundation, and the W.K. Kellogg Foundation. He has authored more than 70 publications and is a Fellow of the American Association for the Advancement of Science, and has served as a member of the Board on Agriculture and Natural Resources. He served on the initial Review Committee that evaluated the AgFF Research Program within NIOSH during 2006 & 2007, as well as on the Framework

Committee of the National Research Council that developed the NIOSH research program review process. Dr. Zuiches received his B.A. in philosophy and sociology from the University of Portland, and his M.S. and Ph.D. in sociology from the University of Wisconsin-Madison.