objective, there is a need to know on a population basis the incidence of active infections that are likely to occur as a function of levels enteric pathogens ingested. This information is needed to make realistic, cost-effective decisions concerning microbiological criteria. For example, if the infection rate at 10,000 cfu/g is 90% whereas at 100 cfu/g it is 0.01%, one could estimate risk factors versus the cost of achieving a significant improvement in public health. Using the cited example, it is unlikely that there would be much practical significance in mandating a minimum level of less than 1 cfu/g if there was not further reduction in infection rate.

3. Determine how techniques in microbial risk assessment can be applied to the transmission of bacterial pathogens via raw beef products. This includes quantifying the relative importance of both the different potential sources of pathogenic bacteria and the critical control points that control the microbiological hazards associated with beef slaughter operations.

4. Establish baseline data for the types and extent (level) of microbial contamination that can be expected on raw beef products produced under good manufacturing conditions. These data will serve as the basis for assessing the efficacy of alternate intervention approaches. This should include an examination of large and small volume slaughter operations for fed-cattle and dairy cattle to determine factors that effect incidence of foodborne pathogens in these segments of the beef industry.

These surveys should be accompanied with an evaluation of the relationship between the results of traditional organoleptic inspections and assessments of both the incidence and extent of contamination with specific human pathogens. Particular emphasis should be directed to assessing the relationship between animal health at the time of slaughter and the overall degree of contamination of the meat.

5. Surveys of the adequacy of refrigeration in distribution channels, retail markets, food service establishments, and the home have indicated that there is a significant potential that raw beef products will be temperature abused before consumption. There is a need to establish quantitative data on the impact of transitory or marginal temperature abuse on the growth of pathogens on raw beef products. Data on time/ temperature relationships would provide a scientific basis for courses of action that should be followed when there is a loss of temperature control.

6. Establish how refrigerated raw beef should be stored to maximize microbiological safety, with particular reference to control of psychrotrophic pathogens.

7. Identify microbiological inhibitors that could be used in raw meat and poultry, particularly ground beef.

8. Evaluate decontamination procedures to determine if they could be employed as an alternate means to trimming for effectively eliminating fecal contamination from carcasses.

9. The continued development of improved methods for the identification of foodborne pathogens in meat and poultry products should be encouraged. This includes rapid methods that can be used both to identify animals that harbor enteric pathogens prior to slaughter and to periodically verify the effectiveness of HACCP operations. Studies of improved means for sampling to decrease lower limits of detection, enhance accuracy, and decrease number of samples required for statistical validity should also be encouraged.

10. It is often assumed that enteric pathogens are limited to the surface of beef carcasses. However, evidence indicates that lymph nodes can harbor enteric pathogens (e.g., salmonellae). This suggests that the processing procedures described in this document would be less effective than anticipated. The relative significance of beef carcass lymph nodes as a potential source of *Salmonella* and *E. coli* O157:H7 is unknown. Studies should be undertaken to determine the incidence of these pathogens in bovine lymph nodes.

Attachment A—General Sanitation Controls for Beef Slaughter and Fabrication Operations

Successful implementation of HACCP within a beef slaughter or fabrication facility requires the following basic plant support programs. Good manufacturing practices (GMPs) must be stressed throughout the facility. These practices include programs that cover employee personal hygiene, effective sanitation, pest management, equipment selection and maintenance, plant environmental management, potable water sources, operational practices, and proper storage of packaging materials and supplies. Effective adherence to GMPs requires orientation and follow-up training for all employees.

A. Hygiene Practices

All personnel should be trained in the importance of personal hygiene.

Hair nets, beard covers, knives, steels, lockers, aprons, smocks, boots, etc., should be handled and maintained in a clean and sanitary manner. Disposable personal items should be changed as required to assure cleanliness.

Hot water sanitizing stations should be kept at 180°F with frequent changes of water. After knives are dipped they should be sanitized by approved sanitizers for an appropriate time interval before reuse. This may require multiple knives to allow adequate time in the sanitizer to assure proper microbial kill.

Knives and all personal equipment should be cleaned, sanitized, and dried prior to storage. Special attention should be given to boots and footwear. Storage lockers should be kept clean and free of dirty clothes, rags, etc.

Shrouds, aprons, gloves, and cotton items should be placed in a marked plastic container after use. These items should be given a proper wash with a chlorine rinse and dried thoroughly before being returned to the processing plant.

B. Equipment

Acquisition of USDA approved equipment should include consideration of ease of cleaning, sanitation, and maintenance.

All equipment should be cleaned and sanitized daily. Pre-operative inspections should be conducted prior to start-up.

All equipment must be maintained in good repair. As materials age, deterioration occurs and care must be taken to monitor the equipment. Preventive maintenance helps ensure equipment works properly and facilitates proper cleaning and sanitizing.

Plastic or metal pallets are preferable, however, if unavailable, wooden pallets may be used provided they are kept dry and clean.

All plastic belts and other food conveyance surface should be inspected frequently, and replaced or resurfaced as soon as there is evidence of cracking, pitting, or other defects that would hamper effective cleaning and sanitizing.

A major equipment concern is controlling material buildup, i.e., bone dust and meat particle accumulation in areas that increase in temperature during processing. Such problems can be minimized by regular cleaning and appropriate documentation of all actions.

C. Movement of Personnel and Equipment

Movement of personnel and equipment between areas, particularly between slaughter and fabrication or