Appendix A: Summary of Hazards and Controls

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
(1) Flammable liquids (e.g., ethanol, gasoline) III.A	Fire/Explosion	Sources of ignition in contact with a flammable liquid or atmosphere. The release of flammable liquid or vapor could be due to: • Improper storage; • Spills; • Equipment malfunctions, e.g., containment failures; ruptures; • Undetected leaks; • Inadequate venting of gases; • Human error; and, • Transportation incidents. Sources of ignition include: • Static electricity; • Smoking; • Electric arcs;	Injuries Death Equipment/facility damage	IV.A Process Safety Management requirements must be implemented if applicable (29 CFR 1910.119) as discussed in IV.A: • Maintaining mechanical integrity. • Management of change. • Training: initial, refresher and documentation. • Establishing safe operating procedures. • Process Hazard Analysis. • Maintenance program. • Incident investigations. • Contractor safety. Engineering controls to prevent the accidental release of ethanol include: • Storing flammable liquids in approved containers and portable tanks (29 CFR 1910.106(a)(35); (29 CFR 1926.152(a)(1); 29 CFR

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
		• Open flames; and, • Lightning strike.		1910.106(d)(2)(i)). • Designing drains to quickly remove spilled chemicals from surfaces into tanks (29 CFR 1910.106(h)(4)(iv)(a)). • Inerting storage tank headspaces, maintaining headspaces too rich to ignite or burn, installing flame arrestors on atmospheric vents. • Equipping tanks and railcars with vapor recovery systems and overfill protection devices that minimize spills from tanks. • Maintaining equipment in an optimal working condition. • Installing continuous monitoring devices in key production areas. • Using safety relief valves to vent excess ethanol streams to safe areas (29 CFR 1910.106(h)(4)(iv)(*a*)). • Ensuring that appropriate ventilation systems are installed and function properly.

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				• Installing automatic fire detection and suppression systems at critical points within production areas, tank storage areas, and ethanol load-out areas. • Installing explosion relief venting (29 CFR 1910.106(h)(3)(iv)). • Ensuring pipes, valves and fittings meet the appropriate design requirements (29 CFR 1910.106(c)(1)(i)). Engineering controls for ignition sources: • Ensure bonding and grounding of equipment as applicable to safely dissipate static electricity. • Installing smoke detectors. • Ensuring that all electrical fixtures and powered equipment used in the flammable liquid areas are rated for Class I electrical environments (29 CFR 1910.307(c); NFPA 70). • Choosing “cold work” over “hot work”. • Installing and monitoring a

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				Lightning Early Warning system. IV.B Safe work practices: • Requiring initial and refresher training for workers on flammability hazards and methods of controlling them. Also retraining workers when there are changes in the process. • Training employees on proper work procedures or practices. • Using fences or barriers to ensure that only authorized personnel work in Class I designated areas. • Posting signs to warn workers when they are entering Class I areas. • Implementing a transportation safety program that includes training drivers. • Maintaining vehicles in good operating condition. • Implementing hot work programs. • Prohibiting open flames, sparks or smoking, near flammable liquids.

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				• Cleaning up spills immediately (29 CFR 1910.106(h)(8)(i)). • Implementing regular equipment/process inspections (at least each shift) and maintenance programs.
(2) Combustible Dusts III.C	Fires/Explosions	Combustible dust release can be due to: • Poor equipment design. • Dust collectors that are poorly designed, not well maintained, or malfunctioning. • Malfunctioning equipment leading to blockages, leakages, etc., in bucket elevators. • Release of grain dusts during loading; cooling; transferring; bulk storage; shelled corn cleaning, crushing, drying, and grinding operations. • Improper housekeeping.	Injuries Death Damage and/or destruction of property and equipment	IV.E Engineering controls for combustible dust release: • Building process equipment to be as dust tight as possible. • Designing equipment (e.g., chutes, transfer points, bucket elevators, and belt conveyors) to minimize dust generation. • Maintaining equipment in an optimal working condition at all times. • Using highly efficient dust collection and aspiration systems to collect any dust that may be released into the air. Engineering controls for ignition sources: • Installing temperature sensors and other related controls like belt

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
		Ignition sources include: • Hot bearing along a belt conveyor. • Use of a conventional vacuum cleaner that is not dust ignition proof (that is not rated Class II electrical equipment). • Smoldering materials may also enter the dust collector where it can ignite dust that was previously collected. • Electrostatic discharge from process equipment. • Tramp metal accidentally conveyed inside the mill with feedstock. • Hot work such as welding, cutting, etc. • Smoking in or near flammable liquid storage or processing areas.		alignment on bearings. • Using electrical equipment and wiring specific to Class II hazardous locations in all areas where combustible dust is generated. • Using automatic systems to detect sparks and smoldering materials, e.g., in ductwork on the outlets in operation areas, such as dryers and mills suspected of causing sparks or smoldering. • Ensuring that equipment prone to electrostatic discharge is properly bonded and grounded. • Installing automatic suppression systems that detect pressure rises in equipment and inject inert materials to suppress an explosion (NFPA 69). • Installing explosion relief venting. • Installing fire detection and suppression systems in dryers, dust collectors and other operations prone to fire. • Implementing proper controls to

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				prevent fires/explosions during hot work and choosing cold work instead of hot work (when feasible). IV.F Safe work practices: • Practicing good housekeeping (29 CFR 1910.272(j)). • Implementing safe work practice programs such as a hot work, confined space entry and lockout/ tagout programs (IV.U). • Implementing safe working procedures that include accounting for and preventing extraneous tools and materials from entering process equipment. • Training all employees on combustible dust hazards and controls. • Conducting a facility dust hazard assessment. • Establishing an effective equipment inspection and maintenance program.

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				• Implementing a permit system for hot work (29 CFR 1910.272(f); 29 CFR 1910.252(a)).
(3) Engulfment III.D	Collapse of a bridged surface Avalanche of a vertical wall	• Standing in flowing or moving grain silos. • Standing on a grain bridge in silos. • Standing on or next to a grain mass in a storage pile. • Opening the external door of a storage bin filled with grain.	Injuries Suffocation Death	IV.G Engineering controls: • Equipping silos, bins and other storage vessels with design features that reduce the need for workers to enter them. • Implementing vigorous lockout/tagout procedures (IV.U) to ensure that grain is not added or removed when employees are inside grain storage bins/tanks, or processing equipment. All mechanical, electrical, hydraulic, and pneumatic equipment which presents a danger to employees inside grain storage structures must be deenergized and disconnected, locked-out and tagged, blocked-off, or otherwise prevented from operating by other equally effective means or methods as required by 29 CFR 1910.272(g)(1)(ii).

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				IV.H Safe work practices: • Establishing operating procedures that prohibit employees from entering stored grain vessels, walking down the grain, entering onto or below a grain bridging condition or anywhere a grain accumulation could fall and engulf a worker. • Implementing measures that preclude workers from working around the perimeter of tall storage piles. • Training workers in the proper handling, storing and processing of grains. • Implementing a safe work entry permit program to thoroughly assess all hazards in cases where workers must enter into vessels or work beneath grain receiving pits. IV.I Personal Protective Equipment (PPE; 29

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				CFR 1910.272(g)(2): • Body harness and lifeline. • The appropriate respirator use may be required.
(4) Confined spaces with hazards that can incapacitate a worker such that he/she cannot self-rescue or ask for assistance; cause serious injuries; or death E.g., silos, process vessels, grain storage bins, and feed hoppers III.G	Accidental exposure to a hazardous atmosphere, e.g., oxygen deficient atmosphere, or to acutely toxic and hazardous substances Worker is crushed in equipment Laceration or crushing injuries from moving mechanical parts, e.g., sweep augers Fires/Explosions	• Atmospheric testing was not conducted before entering the confined space. • Poor ventilation in the confined space. • Workers are not provided with the proper ventilation system/ respirators to protect them from acutely toxic and hazardous substances in the atmosphere. • The energy isolating source (e.g. circuit breaker, disconnect switch) of the equipment was not properly locked out and tagged out before starting work. • Presence of an ignition source in a flammable environment. • Proper fall prevention and fall arrest measures were not used. • Safe work practices are not established/implemented for the work place. • There is no permit process for entering confined spaces with hazards in the work place. • There are no warning signs or procedures to preclude	Asphyxiation Incapacitation Loss of consciousness Entrant is unable to self-rescue or request assistance Death Damage/destruction of property and equipment Serious injuries	IV.P Engineering controls (29 CFR 1910.272(g); 29 CFR 1910.146): • Using continuous forced air ventilation to prevent the accumulation of a hazardous atmosphere during confined space entry and conducting pre-entry atmospheric testing, followed by periodic testing as necessary to monitor conditions. Workers must immediately exit the space when a hazardous condition is detected (29 CFR 1910.146(c)(5)(ii)(E)) . • Using ventilation to eliminate unsafe conditions while workers are in a bin, silo, or tank (29 CFR 1910.272(g)(1)(iii)(A)). • Implementing proper lockout and tagout of equipment (IV.U). • Implementing means of preventing fires and explosions (refer to (1) and

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
	Employee falls from a height within the space	unauthorized entry into the confined space. • Workers are not trained or are not being trained properly.		(2) above). • Using proper fall prevention measures such as the use of guard rails around openings and drop offs. IV.Q Safe work practices: • Implementing a permit program that includes safe working procedures in the confined space. • Placing warning signs at entry points to confined spaces and prohibiting unauthorized workers from entering. • Ensuring that workers are properly trained. Training must include: permit procedures, workers duties, hazards, protective and preventive measures, and any PPE that workers are required to use. • Implementing a maintenance program that includes regular inspections of at least the mechanical and safety control equipment (29 CFR 1910.272(m)(1)(i)&(2)).

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				IV.R PPE: • Providing the proper type of respirators (when needed) to protect entrants from atmospheric hazards in the confined space. • Providing the right type of fall arrest equipment to workers, e.g., body harness and lifeline.
(5) Equipment Ruptures III.B	Release of volatile flammable liquids or combustible dusts due to equipment rupture	• Poor maintenance. • Rise in equipment pressure due to malfunction. • Equipment failures due to leakage, corrosion, fire, etc.	Workers exposure to hazardous chemicals can cause: asphyxiation; incapacitation; loss of consciousness; etc. Release of flammable liquids in the presence of an ignition source can cause: Fires Explosions Injuries Death	IV.C Engineering controls: • Maintaining equipment in safe operating condition at all times to preclude malfunctions. • Installing automatic fire detection and suppression systems at critical points within production areas, such as tank storage areas and ethanol load-out areas. • Installing explosion relief venting. • Purchasing equipment with design features that preclude/limit the occurrence of ruptures. • Using electrical wiring and equipment that is rated for the specific hazardous (classified) location.

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				IV.D Safe work practices: • Implementing equipment/process inspection and maintenance programs, including PSM requirements for covered processes.
(6) Motor Vehicles (e.g., loading, unloading, operating) III.H	Release of flammable vapor in loading/ unloading area Smoking or open flames inside or near vehicles with flammable/ combustible materials Static electricity discharge during loading or unloading of flammable/ combustible materials Vehicle failure/ malfunction Motor vehicle collision with another motor vehicle,	• Sources of flammable vapor include leakage or spillage, e.g., due to malfunctioning equipment. • Smoking and open flames not prohibited inside or near vehicles. • Improper or lack of bonding and grounding. • Motor vehicle in poor working condition. • Pot holes in roads, uneven road surfaces. • Slippery surfaces (e.g., during a snow storm); poor visibility (e.g., fog). • Driver not trained or improperly trained. • Fatigued driver. • Unsafe driving, e.g., exceeding speed limits or driving too fast in poor weather conditions. • Pedestrian and motor vehicle routes not clearly demarcated.	Fires/explosions Injuries/Death Vehicle/property damage	IV.S Engineering controls: • Preventing leakage by maintaining equipment (e.g. piping systems, pumps, valves) in good condition; and installing spill prevention and control measures. • Utilizing proper grounding and bonding mechanisms. • Maintaining vehicles in good working condition. • Maintaining roads around the workplace in good condition. • Installing Lightning Early Warning Systems. Section IV: T Safe work practices: • Prohibiting the loading or unloading of motor vehicles during a lightning storm.

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
	pedestrian, piping, or other structures Lightning strikes			• Prohibiting smoking and open flames inside or near motor vehicles. Designating smoking areas at appropriate distances from motor vehicles and flammable liquid storage or processing areas. • Monitoring road conditions and avoiding transporting goods in inclement weather. • Demarcating roads to separate vehicle and pedestrian traffic. • Implementing a transportation safety program that includes pedestrian safety and driver training. Launching regular awareness campaigns. • Setting driver schedules to allow for breaks, rest periods and compliance with the Department of Transportation's Hours of Service Regulation. • Enforcing speed limits within the workplace. • Conducting regular inspections of motor vehicles and implementing

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				an effective maintenance program.
(7) Exposure to hazardous substances III.F	Uncontrolled release of hazardous substances	• Improper ventilation. • Malfunctioning equipment. • Release of combustion by-products (e.g., carbon monoxide) from equipment.	Asphyxiation Death Injuries Inability to self-rescue or request assistance in a confined space	IV.M Engineering controls: • Using proper ventilation systems. • Enclosing emission sources. • Substituting or eliminating hazardous substances when feasible. IV.N Safe work practices: • Implementing the requirements of the HCS (29 CFR 1910.1200): hazard communication program (29 CFR 1910.1200(e); MSDSs/SDSs and container labelling; training workers. • PSM covered facilities must implement the requirements of the standard (Section I; 29 CFR 1910.119(a)(1); Appendix A of 29 CFR 1910.119). IV.O PPE: Whenever workers' exposure to hazardous substances cannot be eliminated or reduced to acceptable/safe levels, employers must select and provided the proper PPE to affected workers, including training and implement any required safety program, e.g., respiratory

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				protection program.
(8) Hazardous Noise Levels OTM, Section III, Chapter 5, Noise III.E	Repeated exposure to hazardous noise levels	Sources of noise include: • Grain unloading areas: grain dumping, pneumatic blowers, vehicles, vibrators attached to the metal hoppers of vehicles to facilitate complete dumping of grain. • Grain elevators: gallery and basement floors of elevators. • Grain processing.	Impaired hearing Loss of hearing Loss of balance	IV.J Engineering controls: • Grain unloading areas: enclosing pneumatic blowers in booths or separating them from work areas. • Grain elevators: using quieter and/or low speed/high volume conveyor equipment, shutting off conveyor equipment when not in use, minimizing the use of compressed air. • Grain processing: Reducing noise levels at their source; using isolation techniques to separate employees from noise exposures; locating noisy equipment separately from major work areas where employees will be present. IV.K • Hearing Conservation Program (29 CFR 1910.95) IV.L Hearing protection devices: • Employers must provide workers

Hazards	Potential Hazardous Event include	Causes include	Effects include	Controls include
				with hearing protection devices whenever noise exposure levels equal or exceed OSHA's specification (29 CFR 1910.95; 29 CFR 1926.52).
(9) Exposure to Hazardous Energy IV.I	Unexpected start-up of equipment or machinery during maintenance operation	• Failure to lockout/tagout hazardous energy sources before starting work. • Improper lockout/tagout of hazardous energy sources.	Injury Death	IV.U • Implementing proper lockout/tagout procedures before starting work (29 CFR 1910.272(g)&(h); 29 CFR 1910.147).