WASHINGTON State FACE Program
Fatality Assessment & Control Evaluation

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REPORT#: 52-54-2023 **REPORT DATE:** February 6, 2023

Family Dairy Farm Worker Dies When Tractor Rolls Down Embankment

INCIDENT HIGHLIGHTS

DATE:
July 28, 2020

TIME:
3:30 a.m.

WORKER:
56-year-old dairy farm worker

INDUSTRY/NAICS CODE:
Dairy Cattle and Milk Production, 112120

EMPLOYER:
Dairy Farm

SAFETY & TRAINING:
The employer did not have a written Accident Prevention Program (APP).

SCENE:
Dairy farm manure pond

LOCATION:
Western Washington

EVENT TYPE:
Machine

SUMMARY

On July 28, 2020, a 56-year-old family dairy farm worker died when his tractor rolled down an embankment. He was operating a tractor built in 1971 that did not have a rollover protective structure (ROPS) and seat belt. The tractor was towing a 25-plus-foot lagoon pump trailer on a narrow, bumpy, and rutted dirt track road. The road was on the crest of an earthen embankment that surrounded the farm's manure pond. The lone worker was using the pump to agitate water and cow waste solids stored in the pond and spray the mixture as soil fertilizer in nearby feed crop fields. The pond area was dark, as it was two hours before sunrise. The only light came from the tractor and nearby farm buildings. The tractor was traveling close to the unmarked edge of the road. As the tractor turned sharply near its final destination, its front left wheel got caught in a rut that caused the tractor to roll over the edge down the outer slope of the embankment. The worker fell to the ground, and the tractor's 3-point hitch fatally pinned him against his back.

...READ THE FULL REPORT> (p.5)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Rollover protective structure (ROPS) and seat belts not installed.
- No accident prevention program (APP) or safety training.
- Operating near edge of dark, narrow, and rutted embankment road.
- No lighting, warning signs, or reflective markers on embankment road.
- ...LEARN MORE> (p.12)

RECOMMENDATIONS

Washington FACE investigators concluded that, to help prevent similar occurrences, employers should:

- Install manufacturer-approved, certified ROPS and seat belts on tractors.
- Develop a formal, written APP with job hazard analysis (JHA) and ROPS and seat belt safety training requirements.
- Improve tractor safety on embankments by assessing road and slope hazards, installing lights, and marking edges of roads with visual cues, such as reflective driveway stakes.
- ...LEARN MORE> (p.12)

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DEFINITIONS

APP	Accident Prevention Program
CDL	Commercial Driver's License
CFR	Code of Federal Regulations
CSHO	Compliance Safety and Health Officer
DOSH	Division of Occupational Safety and Health
JHA	Job Hazard Analysis
L&I	Washington State Department of Labor & Industries
NIOSH	National Institute for Occupational Safety and Health
NTSC	National Tractor Safety Coalition
OSHA	Occupational Safety and Health Administration
PTO	Power Take-Off
RCW	Revised Code of Washington
ROPS	Rollover Protective Structure
SHARP	Safety & Health Assessment & Research for Prevention
WA FACE	Washington State Fatality Assessment and Control Evaluation Program
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act

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WASHINGTON STATE FACE PROGRAM INFORMATION

The Washington State Fatality Assessment and Control (WA FACE) program is one of many workplace health and safety programs administered by the Washington State Department of Labor & Industries' Safety & Health Assessment & Research for Prevention (SHARP) program. It is a research program designed to identify and study fatal occupational injuries. Under a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH grant# 5 U60OH008487), WA FACE collects information on occupational fatalities in WA State and targets specific types of fatalities for evaluation. WA FACE investigators evaluate information from multiple sources. Findings are summarized in narrative reports that include recommendations for preventing similar events in the future. These recommendations are distributed to employers, workers, and other organizations interested in promoting workplace safety. WA FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are not included in written investigative reports or other databases to protect the confidentiality of those who voluntarily participate in the program.

Additional information regarding the WA FACE program can be obtained from:

WA FACE program website
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INTRODUCTION

In July of 2020, the Washington State Department of Labor & Industries' (L&I) Division of Occupational Safety and Health (DOSH) notified the Washington State Fatality Assessment and Control Evaluation (WA FACE) program of the fatality of a family dairy farm worker who died when his tractor rolled over and crushed him.

Washington State FACE investigators reviewed the DOSH compliance safety and health officer's (CSHO) enforcement case file in lieu of interviewing the employer due to their decision not to participate. Documents reviewed during the course of this investigation included the DOSH inspection summary report, the worker's death certificate, obituary, co-worker interviews, incident scene photos, diagrams, and police report.

EMPLOYER

The employer was a family dairy farm in Western Washington. The farm had business roots going back nearly 50 years. It was incorporated in 2007 as a Washington Limited Liability Company (LLC). The approximately 130-acre farm sold its milk cows in March 2020, but retained a few youngstock. At the time of the incident, the farm employed two full-time workers and a few part-time workers, including family. The owner and his relatives who lived on the farm did much of the work.

WRITTEN SAFETY PROGRAMS and TRAINING

The family farm employed full-time workers who were covered by the Washington Industrial Safety and Health Act (WISHA), chapter 49.17 RCW [RCW 1970]. However, the employer did not have a formal, written accident prevention program (APP) or safety program as required by state safety and health rules [WAC 2001]. This included not holding safety meetings, performing job hazard analyses (JHA), and providing safety training.

WORKER INFORMATION

The deceased dairy farm worker was 56 years old. He worked his entire life on the family farm owned by his father. He learned his job skills from his father, including equipment and facility operation and maintenance, hay production, and animal husbandry. He had decades of experience in farm tractor and machinery operation, manure pond management, and crop irrigation. He gained additional employment as a silage truck driver after the farm sold most of its milk cows in 2020. The worker's wife and teenage son helped perform his farming duties. The worker was a full-time employee covered by laws of the Washington Industrial Safety and Health Act (WISHA) [RCW 1970].

EQUIPMENT

The incident involved a 1971 International Harvester 1066 open-cab row-crop tractor (Photos 1-3). The employer purchased the tractor at an auction in 2019 as a training tractor for the deceased worker's son. The tractor had an International DT-414 inline 6-cylinder turbo diesel engine, 115-horsepower power take-off (PTO), and a drawbar and 3-point hitch to pull farm implements. It had a factory operating weight of 12,148 lbs., top advertised speed of 20 mph, and a maximum pull capacity of 11,625 lbs. The tractor had 11L-15 front tires and 18.4-38 rear tires. With a full 42-gallon fuel tank and no operator, the tractor's center of gravity was at a horizontal distance of 30.1 inches forward from the centerline of the rear wheels, a vertical distance of 41.38 inches above the road, and a horizontal distance of 0 inches from the center of rear wheel tread to the right and left. Its turning radius on a concrete surface was 144 inches with the brake applied and 165 inches without the brake applied [Nebraska Tractor Test 1971]. The tractor also had a Westendorf All-Matic WL-42 front-end loader.

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Photo 1


Photo 2


Photo 3

The incident involved this 1971 International Harvester 1066 open-cab row-crop tractor.

Photo 1: Tractor left rear side profile with 3-point hitch and fenders damaged by rollover.

Photo 2: Tractor left front side profile.

Photo 3: Tractor right side profile with Westendorf WL-42 front-end loader.

The tractor did not have a rollover protective structure (ROPS) and seatbelt. Although the tractor was designed to accommodate ROPS installation, ROPS-certified cabs were optional features until 1975 when federal legislation made them an OSHA requirement for tractors manufactured after October 25, 1976. In Washington State, agriculture workplace safety rules require ROPS for pre-1976 tractors that were built or sold with ROPS as an optional accessory; or according to the manufacturer, the tractor was designed to accommodate the addition of ROPS. Aftermarket certified ROPS and seatbelt were available to be purchased for the tractor.

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When the incident occurred, the tractor was towing a 25-plus-foot steel, single-axle manure lagoon pump trailer (Photo 4). The trailer was coupled to the tractor's drawbar. The trailer had an impeller at the end to agitate water and cow waste solids stored in the farm's manure pond. The homogenized mixture was pumped out of the pond as soil fertilizer through discharge pipes to an irrigation gun in nearby feed crop fields.

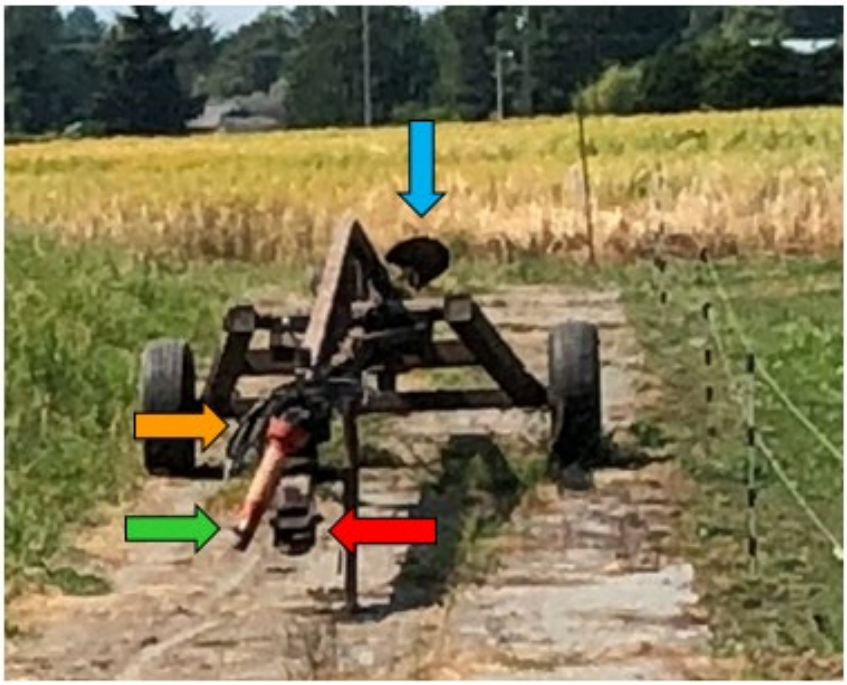

Photo 4: Manure pond pump trailer after incident. Red arrow shows tongue. Green arrow shows PTO shaft. Blue arrow shows pump impeller. Orange arrow shows hydraulic hoses.

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INCIDENT SCENE

The incident happened at the northeast corner of the earthen embankment that surrounded the dairy farm's manure pond, where cow waste solids were stored for future use as soil fertilizer. The rectangular pond was around 130 feet wide and 260 feet long. On the elevated crest of the embankment was a narrow, bumpy, rutted dirt track road (Photos 5-6). The embankment had a 25-degree outer slope covered with tall grass (Photo 7). A dirt road from an area of farm buildings extended west across the pond's north side and ended near its northwest corner. The pond area was dark when the incident occurred, and the only light came from the tractor and farm buildings east of the pond.

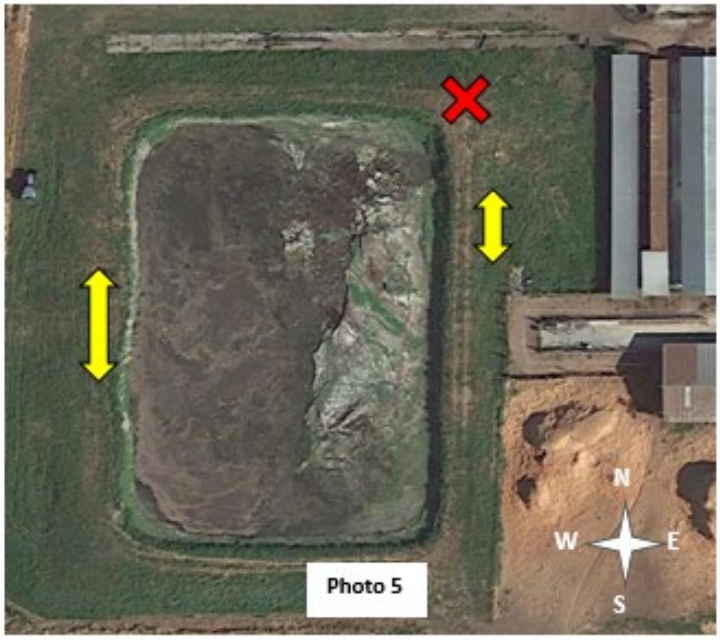

Photo 5: Aerial view of the rectangular manure pond where incident occurred. Red X shows tractor rollover location. Yellow arrows indicate the uneven, rutted, dirt track road on the elevated crest of the pond's earthen embankment. The pond area was dark, and the embankment road had no lighting system, hazard signs, or reflective markers. Photo courtesy of ESRI.

Photo 6: Southwest view of manure pond from crest of embankment.

Photo 7: North side of embankment with 25-degree slope. Manure lagoon pump trailer and discharge pipes are visible in the road below the slope.

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WEATHER

The incident happened around 3:30 a.m. The weather was clear with 10 mph south winds and a temperature of 59 degrees. The moonset was at 12:39 a.m., astronomical twilight at 3:08 a.m., and sunrise at 5:40 a.m. [Weather Underground 2022]. The weather was not a factor in this incident.

INVESTIGATION

When the incident happened, the 56-year-old family dairy farm worker was operating a 1971 International Harvester 1066 open-cab, row-crop tractor. The tractor was towing a 25-plus-foot steel, single-axle lagoon pump trailer coupled to its drawbar. The pump trailer had an impeller on the end that had to be moved in and out of the farm's manure pond at several locations to agitate water and cow waste solids stored in the pond. The homogenized mixture was also being pumped from the pond as soil fertilizer through discharge pipes to an irrigation gun in nearby feed crop fields. To reach the pumping locations, the worker had to drive the tractor on a narrow, bumpy, and rutted dirt track road on the crest of an earthen embankment that surrounded the pond. The pumping process, which was done biannually and sometimes at night, moved slowly due to the difficulty of repositioning the tractor, trailer, and pipes. The worker's teenage son was assisting him as usual, but on the night of the incident, his wife also joined them until he sent her and their son home before the job was finished.

The pond area was dark, as it was two hours before sunrise. The only light came from the tractor and nearby farm buildings located to the east. The lone worker was driving the tractor on the embankment road to his final pumping location on the pond's west side. The tractor was traveling close to the unmarked edge of the road. As the tractor turned sharply near its final destination, its small front left wheel got caught in a rut that caused the tractor to roll over the edge down the 25-degree outer slope of the embankment. The worker fell to the ground, and the tractor's 3-point hitch (Photo 8) fatally pinned him against his back. His wife and son found him crushed around four hours later. The employer, who was the worker's father, called 911 and used another tractor to lift the rolled tractor off the worker's body so the coroner could take custody of it.

Investigators found the worker was operating the nearly 50-year-old tractor without ROPS and a seat belt installed. The employer purchased the tractor at an auction in 2019 as a training tractor for the deceased worker's son. He began using it two days earlier as a backup tractor when the employer's primary tractor had developed engine problems. It is unknown if the worker was trained to use the incident tractor though he expressed a dislike for it to relatives. The compliance safety and health officer (CSHO) was informed by farm machinery experts that when the 1971 tractor was sold new, ROPS or a ROPS-certified cab were optional from the manufacturer (Photo 9). At that time, standard equipment would have been an open-cab tractor without ROPS. Aftermarket certified ROPS and seatbelt were available to be purchased for the tractor.

The worker's relatives who lived on the farm thought they heard the tractor's engine shut off between 2:45 a.m. and 3:30 a.m. and believed he finished agitating the pond. Based on observations of the pinned worker's body, they believed he attempted to jump off the tractor when it started to roll. The pond's embankment had no lighting system, warning signs, or reflective road markers. The employer did not have a written APP or safety training program. Though likely, it is unknown if worker fatigue was a contributing factor in the early morning incident.

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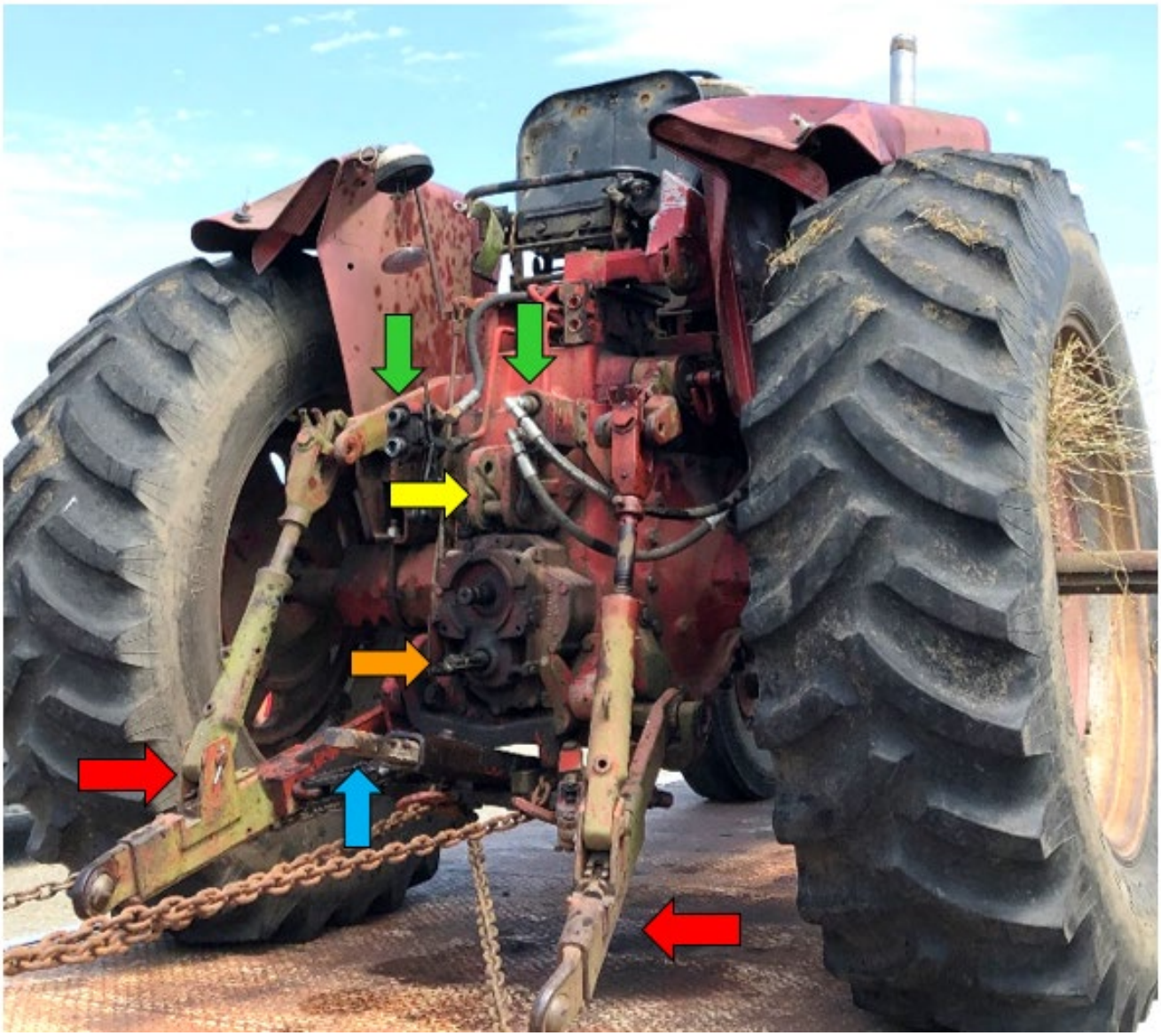

Photo 8: Image of rear of incident tractor. Red arrows point to 3-point hitch lower link arms. Yellow arrow shows hitch's top link arm bracket with arm removed. Blue arrow points to straight drawbar. Orange arrow points to PTO drive shaft. Green arrows indicate hydraulic fluid outlets where right side with hoses powered front-end loader and left side without hoses powered manure lagoon pump trailer.

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Photo 9: Arrows point to manufacturer-made openings to accommodate ROPS installation on incident tractor. During ROPS installation, the fenders are removed, the ROPS is mounted to the axle housing, and the fenders are secured to the ROPS using the holes. Washington State agriculture workplace safety rules require ROPS for pre-1976 tractors that were built or sold with ROPS as an optional accessory; or according to the manufacturer, the tractor was designed to accommodate the addition of ROPS.

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CAUSE OF DEATH

According to the county coroner's office, the manner of death was mechanical asphyxia.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. Washington FACE investigators identified the following recognized hazards and APP deficiencies as key contributing factors in this incident:

- *Rollover protective structure (ROPS) and seat belts not installed.*
- *No accident prevention program (APP) or safety training.*
- *Operating near edge of dark, narrow, and rutted embankment road.*
- *No lighting, warning signs, or reflective markers on embankment road.*

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Install manufacturer-approved, certified ROPS and seat belts on tractors.

Discussion: Tractor rollovers are the leading cause of farm worker fatalities. The best way to prevent rollover fatalities is to install manufacturer-approved, certified ROPS and seat belts on tractors. A ROPS system consists of specially engineered metal roll bars, frames, or crush proof cabs that protect the tractor operator by limiting the rollover to around 90 degrees and creating a protective zone for the operator's body [SCAHIP 2017]. Only approved OSHA 1928.51 CFR or similar National Consensus Standards ROPS must be installed on farm tractors [CFR 2005, WAC 2020a].

Federal OSHA rules require ROPS and seat belts to be equipped on tractors made after October 25, 1976 [CFR 2005]. In Washington State, more inclusive ROPS retrofitting rules require pre-1976 tractors to have ROPS if the tractor was built or sold with ROPS as an optional accessory; or according to the manufacturer, the tractor was designed to accommodate the addition of ROPS [WAC 1997]. However, many older tractors, such as the one in the incident, still do not have ROPS and seat belts, even though aftermarket certified ROPS are available for purchase for many models. A WA FACE survey in 2007 found that while pre-1976 tractors were used 35% less than newer tractors, 70% did not have ROPS [Spielholz et al. 2007]. The National Tractor Safety Coalition (NTSC) recommends professional retrofitting of ROPS to ensure proper attachment and durability [NTSC 2022, SCAHIP 2017]. Purchase of ROPS and professional installation can be arranged by contacting the tractor manufacturer or a local farm equipment dealer. Old tractors that cannot be retrofitted with ROPS should be removed from service.

For ROPS to be effective, it must always be used with the seat belt fastened as required by Washington State agriculture workplace safety rules [WAC 2020b]. When used with a seat belt, ROPS is 99% effective in preventing serious injury and death. Without a seat belt, the tractor or ROPS itself could crush the operator during a rollover. The seat belt should be tight enough to keep the operator within the ROPS protective area. The seat belt and seat belt anchorage must meet the requirements of ANSI/SAE J800 April 1986, Motor Vehicle Seat Belt Assemblies. Where a suspended seat is used, the seat belt must be fastened to the movable portion of the seat. Seat belt webbing material must also be in safe, serviceable condition. Operators should inspect ROPS and the seat belt before starting work and never operate a tractor if the equipment is missing or damaged. Misuse of ROPS and seat belts should also be avoided. Employers should routinely inspect tractors to make sure ROPS and seatbelts are in safe condition and operators are following equipment safety requirements.

Recommendation #2: Develop a formal, written APP with job hazard analysis (JHA) and ROPS and seat belt safety training requirements.

Discussion: Having a company APP or safety program can effectively protect farm workers from hazards that can cause serious injuries and fatalities. Washington State workplace safety rules require every employer, including family farms, with one or more workers to develop a formal, written APP. The APP should be tailored to the needs of the operation and to the specific hazards involved [WAC 2021]. A comprehensive APP that exceeds basic state requirements offers the best defense against hazards.

A common obstacle to developing an APP is knowing how to get started. Helpful resources are available online that provide step-by-step instructions and examples to follow [OSHA 2016, LNI 2022]. Free on-site safety program consultation services are also available upon request [LNI 2021]. One of the most critical features an APP should have is a Job Hazard Analysis (JHA) requirement [OSHA 2002]. A JHA helps employers identify and assess risks and severity of hazards associated with equipment, tools, job tasks, and environments, such as tractor operation, manure pond management, embankment conditions, working alone, and working at night. The JHA should be documented on a standardized form that should also provide space for listing hazard solutions or controls, such as safety equipment, policy requirements, and safety training. Employers should periodically review and update JHAs whenever new hazards are identified or changes to the original hazardous condition occur. Workers should be able to access and review completed JHA forms at any time.

An APP should have a safety training program that includes ROPS and seat belt training for tractor operators [WAC 2018b, WAC 2020b]. Operators should be trained in the operation of the tractor to be used, including an orientation to the topography of the land where they will operate the tractor. At a minimum, training should instruct operators how to do the following:

- Perform pre-trip inspections.
- Tighten seat belts to keep their body within ROPS protective area.
- Avoid driving near ditches, holes, embankments, and steep slopes.
- Slow down on sloped, bumpy, slippery, or muddy terrain.
- Drive smoothly, without jerky starts, stops, or turns.
- Stay alert, especially at row ends, on roads, and near trees.
- Use hitch points and heights recommended by manufacturer.
- Never carry passengers.
- When parking, set brakes securely and use park lock if available.

Additional hands-on refresher training can help ensure operators are familiar with the controls, capabilities, and limitations of farm tractors. Training effectiveness can be evaluated by using knowledge and skills tests, such as written exams, obstacle courses, and group problem-solving activities. Employers can also seek to have tractor operators attend farm machinery safety workshops, webinars, and certification trainings whenever possible. Operator training records should be kept on file and periodically reviewed to make sure training is relevant and current.

Recommendation #3: Improve tractor safety on embankments by inspecting and maintaining roads and slopes, installing lights, and marking edges of roads with visual cues, such as reflective driveway stakes.

Discussion: If tractor operation on embankments is unavoidable, then employers should routinely inspect and maintain embankments to ensure safe operating conditions. Erosion from severe rainfall, strong wind, tree roots, burrowing animals, and frequent vehicle and pedestrian traffic makes embankments unstable and hazardous for tractor operators.

Inspections should look for cracks, slides, and depressions on embankment crests and slopes. After heavy rains, roads should be inspected for water puddles in ruts and potholes where internal seepage can occur. Concrete, metal, wood, and plastic structures on embankments should be checked for cracks, movement, and wear. Embankments should have grass cover to reduce erosion. Routine mowing of grass and clearing of debris can optimize visual inspection and maintenance of the embankment. Trees should never be planted or allowed to grow on or around embankments [USACE 2006]. Embankment roads should be made wide enough to keep tractors a safe distance away from edges and slopes. Roads should be maintained and repaired to provide smooth, even, and stable driving surfaces for tractors.

Visible signs of embankment instability indicate maintenance or repair may be required. Even minor damage can lead to major structural failure. Keeping inspection records on file can help determine if a condition is new or changing. Tractor operation should not be allowed in areas showing rapidly changing conditions, such as large cracks and deep ruts, until the condition is professionally repaired. Embankments should have sufficient lighting if tractor operation goes on during hours of darkness. Lighting should allow tractor operators to easily see equipment controls, road surfaces, pedestrians, posted signs, and reflective stakes. Warning signs can be posted on the embankment to remind operators to drive slowly and alert them of turns, corners, bumps, slopes, and crossing points. Reflective stakes can be installed along the edges of roads to help keep operators a safe distance away from slopes. Operators should work with a trained spotter when maneuvering equipment near blind spots on the embankment.

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INVESTIGATOR INFORMATION

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ACKNOWLEDGMENTS

This report was reviewed by stakeholders from labor and business communities and various Washington State and Federal worker safety agencies. Though we are unable to acknowledge specific individuals for their contributions to this report, we would like to recognize the following for their help and support of the FACE mission and objectives:

- Washington State Division of Occupational Safety and Health (DOSH)
- Federal FACE Program management (NIOSH)
- Occupational Safety and Health Administration (OSHA)
- Safety & Health Assessment & Research for Prevention (SHARP)