

VIII. APPENDIX B

EXAMPLES OF ACCIDENTS PREVENTABLE BY  
GOOD ENERGY CONTROL TECHNIQUES

APPENDIX B

DESCRIPTION OF ACCIDENT	REFERENCE [NO. IN BRACKETS]	HAZARD TYPE	ACCIDENT CAUSES	ENERGY SOURCE	ENERGY CONTROL METHOD
1. WITHOUT DISCONNECTING THE ELECTRICAL SOURCE, AN EMPLOY- EE ATTEMPTED TO BREAK A CON- NECTION IN A 2300-VOLT CIRCUIT (WITHOUT ALSO TESTING THE CIRCUIT), RESULTING IN FATAL ELECTROCUTION.	[4]	SHOCK  FATALITY	1	ELECTRICAL	ELECTRICAL DISCONNECT
2. WHILE MAKING ADJUSTMENTS TO A DUMB WAITER, THE BACK OF A MECHANIC'S HEAD MADE CONTACT WITH AN OPEN ELECTRICAL RESET SWITCH RESULTING IN CONVULSIVE SHOCK AND A SEPARATED AND FRACTURED SHOULDER.	[1]	SHOCK  FRACTURE	1	ELECTRICAL	ELECTRICAL DISCONNECT
3. AN ELECTRICIAN WAS ELECTROCUTED WHILE REPAIRING A 480-VOLT ELEC- TRICAL CABLE IN AN AUTOMOBILE MANUFACTURING PLANT.	[2]	SHOCK  FATALITY	1	ELECTRICAL	ELECTRICAL DISCONNECT
4. AN EMPLOYEE WAS DISMANTLING A DRILLING RIG. AFTER REMOVING THE MAIN PIN ON THE BOOM, HE WAS MOVING TO THE CONTROL STATION WHEN THE BOOM FELL AND STRUCK HIM. HE HAD FAILED TO INSTALL THE SAFETY PIN.	[2]	IMPACT  FATALITY	1	GRAVITY	BLOCKING DEVICE
5. THE CONVEYOR STARTED UP AS THE MAN WAS STANDING ON IT TO WORK ON AN OVERHEAD CHUTE.	[88]	IMPACT  FATALITY	1	TRANSLATION	ELECTRICAL DISCONNECT
6. A MAN WAS CAUGHT BETWEEN A VERTICAL CONVEYOR AND A BARRIER GUARD.	[89]	CRUSHED  FATALITY	1	TRANSLATION	ELECTRICAL DISCONNECT

7.	[4]	CRUSHED FATALITY	1	TRANSLATION	BLOCKING DEVICE
A REPAIRMAN WAS CRUSHED BETWEEN TWO PATTERNS OF COPE MACHINE UNDER AIR PRESSURE.					
8.	[13]	CRUSHED FATALITY	1	TRANSLATION	ELECTRICAL DISCONNECT
A HOPPER GATE CLOSED ON THE TORSO OF A WELDER WHO WAS REPAIRING THE HOPPER LINING.					
9.	[2]	LACERATIONS FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS CLEANING ON THE UNGUARDED SIDE OF A GRANITE WIRE SAW WHEN HE SLIPPED AND FELL. HE WAS CAUGHT BY THE WIRE CLOSEST TO THE OUTSIDE OF THE IDLER WHEEL AND PULLED INTO THE NIP POINT AREA, RESULTING IN FATAL INJURIES.					
10.	[1]	AMPUTATION INJURED	1	ROTATION	ELECTRICAL DISCONNECT
A REPAIRMAN ATTEMPTED TO CLEAN A FILTER WHEEL WHILE IT WAS IN OPERATION. LOSING HIS BALANCE, HE FELL ON THE WHEEL; HIS LEG WAS CAUGHT BETWEEN THE MOVING WHEEL AND THE ROLLER RESULTING IN A CRUSHED LEG THAT HAD TO BE AMPUTATED.					
11.	[89]	CRUSHED FATALITY	1	TRANSLATION	ELECTRICAL DISCONNECT
A JOBSETTER WAS HAVING PROBLEMS WITH A SWITCH ON AN UNLOADING FIXTURE OF AN AUTOMATIC TRANSFER LINE. THE GUARD WAS REMOVED TO OBSERVE THE OPERATION OF THE SWITCH. AS THE UNLOADER ACTUATED, IT CAUGHT THE MAN AND SQUEEZED HIM BETWEEN THE MOVING UNLOADER AND THE SUPPORT POST FOR THE GUARD.					
12.	[2]	CRUSHED FATALITY	1	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS LUBRICATING THE CHAIN DRIVE LINKS IN A CONVEYOR BELT SYSTEM THROUGH A 10" X 12" OPENING BETWEEN THE BINS AND THE METAL GUIDE POST OF THE UNSTACKER WHILE THE MACHINERY WAS RUNNING. AS THE BINS MOVED FORWARD, HIS HEAD WAS CAUGHT BETWEEN THE BIN AND THE GUIDE POST.					

13.	[1]	CONTUSION INJURED	1	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS WORKING ON FOUR DIVERTER VALVES INSIDE A CABINET WHEN A VALVE WAS ACTIVATED BY COMPUTER CONTROL. THE EMPLOYEE WAS STRUCK ON THE SIDE OF HEAD BY THE VALVE ARM.					
14.	[2]	LACERATIONS FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE HAD BEEN FEEDING WASTE PAPER INTO AN INTAKE DUCT FAN ASSEMBLY OF A PAPER SHREDDER AFTER REMOVING THE FAN COVER. WITH THE FAN STILL OPERATING, HE ATTEMPTED TO REPLACE THE COVER WHEN HE WAS PULLED INTO THE FAN RESULTING IN A FATALITY.					
15.	[2]	CRUSHED FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS STANDING ON A STRUCTURAL BEAM OF A SHAKER ATTEMPTING TO UNJAM SAWDUST IN AN AUGER WITH A STICK WHEN HE WAS PULLED INTO THE AUGER AND CRUSHED TO DEATH.					
16.	[2]	LACERATIONS FATALITY	1	ROTATION	PNEUMATIC DISCONNECT
WHILE AN EMPLOYEE WAS CLEANING A BRICK CUTTER MACHINE WITHOUT TURNING OFF AIR PRESSURE, THE MACHINE WAS ACCIDENTALLY ACTIVATED, AND HE WAS DRAGGED INTO THE CUTTER.					
17.	[1]	AMPUTATION INJURED	1	ROTATION	ELECTRICAL DISCONNECT
AN OPERATOR REMOVED THE SLEEVE FROM A BAGGING MACHINE TO CLEAR AN OBSTRUCTION FROM THE FEED SCREW. THE MACHINE WAS STILL RUNNING, AND HIS FINGER WAS CAUGHT.					
18.	[1]	AMPUTATION INJURED	1	ROTATION	ELECTRICAL DISCONNECT
A MACHINE OPERATOR WAS ATTEMPTING TO UNJAM VINYL MATERIAL IN THE AIR LOCK PORTION OF A RECLAIM SYSTEM. A HATCH ABOVE THE AIR LOCK WAS OPENED, AND HE REACHED INTO THE THROAT WITH HIS HAND TO PUSH THE MATERIAL FREE. HIS HAND WENT DOWN INTO THE ROTATING VANES AND HIS FINGER WAS AMPUTATED.					

19.	[1]	LACERATIONS INJURED	1	ROTATION	ELECTRICAL DISCONNECT
AN OPERATOR ATTEMPTED TO CLEAN OUT THE DOOR TRACK OF A DRYER WITHOUT TURNING THE MACHINE OFF WHEN THE AGITATOR STRUCK HIS FINGER.					
20.	[1]	AMPUTATION INJURED	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE REMOVED A COVER FROM A SCREW CONVEYOR TO CHECK IF IT WAS RUNNING. HE LOST HIS BALANCE AND STUCK HIS FOOT INTO THE CONVEYOR.					
21.	[2]	CHOKED FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE ATTEMPTED TO REMOVE SOME CLOGGED COMPOST MATERIAL THAT HAD JAMMED AN OPERATING KILN DISCHARGE CONVEYOR. HIS CLOTHING BECAME ENTANGLED IN THE UNGUARDED REVOLVING ROLLERS. HIS ARM WAS CAUGHT IN THE MACHINE. HE WAS PULLED AGAINST THE MACHINE AND WAS CHOKED TO DEATH.					
22.	[2]	CRUSHED FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS ATTEMPTING TO CLEAR A JAM ON A GARNETT MACHINE WHILE IT WAS IN OPERATION. HE CRAWLED INSIDE THE MACHINE THROUGH AN UNGUARDED HOLE WHERE HE BECAME ENTANGLED IN MOVING PARTS, WAS DRAWN INTO THE ROLLER AND WAS CRUSHED.					
23.	[2]	LACERATIONS FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS CLEANING AN EDGER SAW IN A SAWMILL. PROTECTIVE PANELS WERE REMOVED. HE REQUESTED ANOTHER EMPLOYEE TO START THE SAW. HIS CLOTHES BECAME ENTANGLED AND HE WAS PULLED INTO THE SAW.					
24.	[2]	CRUSHED FATALITY	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS EMPTYING DOUGH FROM A MIXER WHILE IT WAS STILL RUNNING. WHEN HE REACHED INTO THE MACHINE HIS ARM WAS CAUGHT AND HE WAS PULLED INTO THE MACHINE.					

25.	[2]	CRUSHED	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE REACHED TO FREE A CLOTH THAT HAD WRAPPED AROUND THE WHIPROLL OF AN OPERATING TEXTILE DOLLEY WASHER. HIS HAND WAS CAUGHT IN THE CLOTH AND HE WAS DRAGGED INTO THE WHIPROLL.					
26.	[2]	CRUSHED	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS USING A HOOK TO CLEAN THE WOOL FROM THE BRUSH ROLLER OF A YARN CARDING MACHINE WHILE IT WAS RUNNING. HE WAS PULLED INTO THE MACHINE.					
27.	[2]	CRUSHED	1	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS WIPING THE MIXER SHAFT WITH A LARGE RAG WHILE THE MIXER WAS RUNNING. THE CLOTH BECAME ENTANGLED AND PULLED HIM AGAINST THE STEEL ARM THAT HELD THE SHAFT.					
28.	[1]	BURNS	2	ELECTRICAL	ELECTRICAL DISCONNECT
AN ELECTRICIAN WAS REPAIRING A BURNED FEEDER TO A FURNACE. HE GRASPED A AND B PHASE FEEDERS, A CURRENT PASSED THROUGH BOTH ARMS AND CHEST CAUSING BURNS TO BOTH HANDS AND A FALL. AUXILIARY POWER WAS STILL ON.					
29.	[5]	SHOCK	2	ELECTRICAL	ELECTRICAL DISCONNECT
A PLANT ELECTRICIAN WAS REPAIRING SOME DAMAGED ELECTRICAL CABLES. CIRCUIT BREAKERS HAD BEEN OPENED IN A SUBSTATION. AS HE CUT ONE OF THE CABLES, HE WAS ELECTROCUTED. PROPER VOLTAGE TESTS WERE NOT MADE PRIOR TO BEGINNING WORK.					

30.	[2]	CRUSHED	2	TRANSLATION	ELECTRICAL DISCONNECT
<p>AN EMPLOYEE WAS PERFORMING DRYWALL REPAIRS FROM THE INSIDE OF AN ELEVATOR SHAFT RATHER THAN FROM THE OUTSIDE AS INSTRUCTED. A WOODEN BEAM WAS USED TO JAM THE ELEVATOR DOOR ON THE SECOND FLOOR AND THE OUTSIDE PANEL SWITCH ON THE MAIN FLOOR HAD BEEN TURNED OFF. THE EMPLOYEE WAS CRUSHED TO DEATH BY THE ELEVATOR WHEN WORKING ON THE MAIN FLOOR BECAUSE THE ELEVATOR RETURNED TO ITS HOME BASE RATHER THAN REMAINING ON THE SECOND FLOOR.</p>					
31.	[2]	CRUSHED	2	TRANSLATION	ELECTRICAL DISCONNECT
<p>THE WASTE HOGGER OPERATOR CLEANING THE MACHINE FELL INTO A CONVEYOR AND WAS PULLED INTO A 14-INCH OPENING AND CRUSHED. THE HOGGER HAD BEEN TURNED OFF BUT NOT THE CONVEYOR.</p>					
32.	[2]	IMPACT	2	TRANSLATION	ELECTRICAL DISCONNECT OR BLOCKING DEVICE
<p>AN EMPLOYEE WAS PARTIALLY INSIDE AN ASPHALT MIXING MACHINE CHANGING PADDLES. ANOTHER EMPLOYEE ACCIDENTALLY HIT A TOGGLE SWITCH WHICH CLOSED THE DOOR OF THE MIXER, STRIKING THE MAN.</p>					
33.	[1]	FRACTURE	2	ROTATION	ELECTRICAL DISCONNECT
<p>A WORKER WAS REPLACING A V-BELT ON A DUST COLLECTOR BLOWER. HE HAD SHUT DOWN THE UNIT BY A LOCAL SWITCH ONLY. AN OPERATOR IN THE CONTROL ROOM RESTARTED THE UNIT, USING A REMOTE SWITCH CENTER. THE WORKER'S HAND WAS CAUGHT BETWEEN THE PULLEY AND BELTS RESULTING IN CUTS AND A FRACTURED FINGER.</p>					
34.	[91]	CRUSHED	3	TRANSLATION	BLOCKING DEVICE
<p>AN EMPLOYEE REMOVED A JAM FROM A PACKAGING MACHINE WITH THE POWER TURNED OFF. RESIDUAL HYDRAULIC PRESSURE ACTIVATED THE HOLDING DEVICE.</p>					

35.	[1]	ACID BURNS  INJURED	4	ELECTRICAL	ELECTRICAL DISCONNECT AND/OR SLIP BLIND
TWO EMPLOYEES HAD OPENED A PIPE-LINE FOR REPAIRS WHEN A THIRD EMPLOYEE STARTED A FEED PUMP. TWO EMPLOYEES WERE SPRAYED WITH ACID.					
36.	[1]	CAUSTIC BLIND  INJURED	4	ELECTRICAL	ELECTRICAL DISCONNECT
A MECHANIC WAS REPAIRING A CAUSTIC PUMP WHEN A COWORKER ACCIDENTALLY ENERGIZED THE PUMP AND SPRAYED THE MECHANIC WITH CAUSTIC.					
37.	[1]	CHEMICAL  INJURED	4	PRESSURE	SLIP BLIND OR VALVE CHAINED IN CLOSED POSITION
AN EMPLOYEE RECEIVED CHEMICAL BURNS WHEN A COWORKER IN THE CONTROL ROOM OPENED A VALVE TO A DISCONNECTED LINE THAT WAS IN THE PROCESS OF BEING TESTED.					
38.	[4]	BURNS  FATALITY	4	THERMAL	SLIP BLIND OR VALVE CHAINED IN CLOSED POSITION
AN EMPLOYEE WAS IN THE PROCESS OF CUTTING A PIPE WHEN DIESEL FUEL WAS MISTAKENLY DISCHARGED INTO LINE AND WAS IGNITED BY THE TORCH.					
39.	[91]	CRUSHED  INJURED	4	TRANSLATION	ELECTRICAL DISCONNECT
A REPAIRMAN WAS CRUSHED WHEN ANOTHER EMPLOYEE ACTIVATED A CONVEYOR IN A COKE FURNACE.					
40.	[2]	CRUSHED  FATALITY	4	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS GREASING BEARINGS ON THE ROLLERS OF A LOG CART MACHINE. HE ACCIDENTALLY TRIPPED A LEVER CAUSING A ROLLER TO MOVE WHICH CRUSHED HIM.					
41.	[2]	CRUSHED  FATALITY	4	TRANSLATION	ELECTRICAL AND/OR PNEUMATIC DISCONNECT
WHILE SETTING UP A VACUUM FORMING PRESS, AN EMPLOYEE LEANED OVER THE PRESS AND ACCIDENTALLY ACTIVATED THE START SWITCH AND WAS CRUSHED.					



42.	[2]	CRUSHED FATALITY	4	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS REPAIRING A CONVEYOR INSIDE A COKE FURNACE WHEN ANOTHER EMPLOYEE ACTIVATED THE CONVEYOR.					
43.	[1]	AMPUTATION INJURED	4	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS WORKING AT TOP OF A KILN LARRY WHEN ANOTHER EMPLOYEE CAUSED THE COUNTERWEIGHT TO DROP.					
44.	[2]	LACERATIONS FATALITY	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE ACCIDENTALLY ACTIVATED THE CARRIAGE CONTROL LEVER IN THE BOOTH. THE BOOTH MOVED, THROWING HIM INTO THE 36-INCH SAW BLADE.					
45.	[1]	IMPACT FATALITY	4	ROTATION	ELECTRICAL DISCONNECT
A MAINTENANCE MAN INSIDE A LARGE MIXING DRUM MAKING REPAIRS WAS STRUCK BY THE BEATER BLADES WHEN THEY WERE INADVERTENTLY ACTIVATED.					
46.	[1]	IMPACT INJURED	4	ROTATION	ELECTRICAL DISCONNECT
A UTILITY MAN WAS USING A TOOL TO TURN THE FEED ROLL MOTOR OF A STAPLE MACHINE FOR CLEANING. THE MOTOR WAS TURNED ON ACCIDENTALLY AFTER HE GAVE VERBAL INSTRUCTIONS, "DON'T START MOTOR." HE WAS STRUCK ON THE ARM BY THE TOOL.					
47.	[1]	LACERATIONS INJURED	4	ROTATION	DISCONNECT ALL ENERGY
AN EMPLOYEE WAS WORKING ON AN AGITATOR IN A PIT WHEN SOMEONE ELSE STARTED THE AGITATOR AND ALSO COMMENCED FILLING THE PIT WITH WATER AND STOCK. HE RECEIVED MULTIPLE CONTUSIONS, ABRASIONS, AND LACERATIONS TO LEGS, HIP, AND SCALP.					
48.	[91]	CRUSHED INJURED	4	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS INJURED WHEN THE PLASTIC PELLETIZER HE OPERATED ACCIDENTALLY ACTIVATED WHILE HE WAS REACHING THROUGH AN UNGUARDED PORTHOLE TO CLEAN IT.					

49.	[2]	CRUSHED	4	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS WORKING ON A MOLD- ING MACHINE TURNTABLE. HE WAS STANDING BETWEEN THE TRANSFER ARM AND THE WEIGHT CHANGER WHEN HE ACCIDENTALLY ACTIVATED THE CON- TROLS OF THE TRANSFER ARM. THE TRANSFER ARM CRUSHED HIM AGAINST THE WEIGHT CHANGER.					
50.	[2]	CRUSHED	4	TRANSLATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS INSIDE A TIE- BORING MACHINE ADJUSTING THE SWITCHES TO RELIEVE A JAM WHEN THE CONVEYOR SYSTEM STARTED MOVING CAUSING HIM TO BE CAUGHT BETWEEN A TIE AND THE BORING MILL.					
51.	[2]	CRUSHED	4	TRANSLATION	ELECTRICAL CONNECT OR BLOCKING DEVICE
TWO EMPLOYEES WERE OPERATING A PRESS BRAKE. THE WORK PIECE WAS BEING REPOSITIONED FOR THE NEXT OPERATION. ONE EMPLOYEE HAD HIS HEAD IN THE POINT OF OPERATION WHEN THE PRESS WAS ACTIVATED ACCIDENTALLY BY THE OTHER EMPLOYEE.					
52.	[18]	CRUSHED	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS CLEANING A FLOUR BATCH MIXER WHEN THE START SWITCH WAS INADVERTENTLY ACTIVATED CRUSH- ING HIS NECK.					
53.	[2]	CRUSHED	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS CLEANING THE INSIDE OF A PUG MILL MIXER SILO WHEN ANOTHER EMPLOYEE STARTED THE MACHINE.					
54.	[1]	AMPUTATION	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS REPLACING A ROLLER CHAIN KEY AND SPROCKET FOR A SET OF ROLLS ON METAL SCRUBBER WHEN SOMEONE ELSE JOGGED THE MACHINE AND CAUGHT HIS FINGERS.					

55.	[1]	CRUSHED	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS CLEANING A PELLET MACHINE WHILE THE GUARD OVER THE FEED ROLLS WAS REMOVED. HE ACCIDENTLY STARTED THE MACHINE AND HIS HAND BECAME CAUGHT IN THE ROLLS.					
56.	[1]	CRUSHED	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS TRAPPED BETWEEN THE BLENDER SHELL AND THE OPENED DOOR HE WAS WORKING THROUGH WHEN THE BLENDER WAS ACCIDENTALLY ENERGIZED.					
57.	[1]	LACERATIONS	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS TRAPPED INSIDE A MIXER WHEN IT WAS ACCIDENTALLY ENERGIZED BY ANOTHER EMPLOYEE.					
58.	[1]	AMPUTATION	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE REMOVED THE HOSE FROM THE CLEANOUT OPENING OF A PUMP AND COMMENCED CLEANING OUT THE PUMP WITH HIS HAND. A COWORKER STARTED THE PUMP RESULTING IN AMPUTATION OF A FINGER.					
59.	[1]	FRACTURE	4	ROTATION	ELECTRICAL DISCONNECT
AN EMPLOYEE WAS CLEANING THE DRIVE PULLEY OF A CENTRIFUGE CONVEYOR. THE CONVEYOR SUDDENLY BEGAN MOVING DRAWING HIS ARM IN BETWEEN THE PULLEY AND THE BELT RESULTING IN FRACTURES OF HIS ARM. A COWORKER HAD ENERGIZED THE CONVEYOR.					

IX. APPENDIX C

EVALUATION OF EXISTING STANDARDS  
INTERNATIONAL, NATIONAL, STATE, AND CONSENSUS

## Appendix C

### EVALUATION OF EXISTING STANDARDS - INTERNATIONAL, NATIONAL, STATE, CONSENSUS

The following paragraphs compare and evaluate the current national, state, international, and consensus standards related to energy controls (lockout/tagouts) for accomplishing maintenance and servicing activities safely. Specifically, the guidelines recommended are compared with: OSHA General Industry Standards (29 CFR 1910) and OSHA Construction Standards (29 CFR 1926); State Standards (with approved OSHA plans); criteria developed in Canada (Alberta), Germany, and Britain; and consensus standards ANSI Z244.1-1982 and NFPA 70E part II.

#### Summary

Appendix Tables C-1, C-2, and C-3 present an overall comparison of the recommended guidelines with the respective national, state, international, and consensus standards. Even though the types of energy applicable and the industries affected vary, a considerable consistency is found in the guidelines required for all except the OSHA national standards and the state OSHA standards (with the exceptions of California and Michigan). The primary criteria elements eliminating energy, securing the means by which the energy is eliminated, verifying that energy has dissipated to safe levels, documenting the procedures, and training the personnel involved, are found consistently in the other standards.

The existing national OSHA standards are inadequate because of incomplete industry coverage and incomplete and inconsistent criteria where standards exist. The existing state standards, with the exception of those for California and Michigan, are reprints of the national standards. The California and Michigan standards closely parallel the recommended guidelines; however, they do not provide the three alternate means of securing the point(s) of control as provided by the recommended guidelines. The California standards are also limited to electrical energy and mechanical motion of equipment; whereas, the recommended criteria cover electrical, mechanical, and thermal energy.

The existing Alberta, Canada, regulations lack effectiveness since they do not include mechanical motion or thermal energy as applicable forms of energy that personnel must be safeguarded against. Also, the Alberta regulations do not specify the documenting of procedures and training of personnel as necessary requirements for an effective program for controlling hazards during maintenance.

The draft German Accident Prevention Specifications do not include electrical, chemical, or thermal as applicable forms of energy to be controlled during maintenance and servicing. Industries affected by the specifications are limited to "power driven equipment" which excludes many industries that expose workers to hazardous levels of energy during maintenance. The German specifications do not require verification that hazards have been controlled, documenting of procedures, or training of personnel in safe work practices.

TABLE C-1  
COMPARISON SUMMARY OF  
TYPES OF ENERGY

RECOMMENDED GUIDELINES: Mechanical motion; potential energy due to pressure, gravity, or springs; electrical energy; thermal energy resulting from high or low temperature.

<u>NATIONAL</u>	<u>STATES*</u>	<u>INTERNATIONAL</u>			<u>CONSENSUS</u>	
		ALBERTA CANADA [92]	GERMANY [46]	BRITAIN [71]	ANSI Z244.1-1982 [5]	NFPA 70E Part II [54]
Electrical energy; hydraulic pressure; thermal energy. Mechanical motion is implied but not stated.	Essentially identical to the national OSHA standard except for California. California standards apply to electrical energy and mechanical motion.	Potential energy, power, chemical energy.	Mechanical motion, potential energy.	Mechanical motion.	Electrical, mechanical, hydraulic, chemical, nuclear, and thermal energy.	Electrical energy.

\*States reviewed: AL, AZ, CA, HI, IN, IA, KY, MD, MI, MN, NC, NV, OR, SC, TN, VT, WA, and WY.

TABLE C-2  
COMPARISON SUMMARY OF  
INDUSTRIES AFFECTED

RECOMMENDED GUIDELINES: Those industries that expose workers to hazardous levels of energy during maintenance.

<u>NATIONAL</u>	<u>STATES*</u>	<u>INTERNATIONAL</u>			<u>CONSENSUS</u>	
		ALBERTA CANADA [92]	GERMANY [46]	BRITAIN [71]	ANSI Z244.1-1982 [5]	NFPA 70E Part II [54]
Overhead and gantry cranes; woodworking; mechanical power presses; forging machines; pulp, paper, and paperboard mills; textiles; bakeries; sawmills; telecommunications; and construction.	Same as the national OSHA standard except for California. California lock-out standards are applicable to electrical and general industry.	Machinery and equipment, powered mobile equipment and hoists.	Power driven equipment.	Machinery and processes applicable to all sectors of industry.	Not specified.	Not specified. Applies to anyone who works on, near or with electric circuits and equipment.

\*States reviewed: AL, AZ, CA, HI, IN, IA, KY, MD, MI, MN, NC, NV, OR, SC, TN, VT, WA, and WY.

TABLE C-3  
COMPARISON SUMMARY OF  
CRITERIA REQUIREMENTS

RECOMMENDED GUIDELINES: Energy shall be isolated, blocked, dissipated, secured, verified. Procedures shall be documented and personnel shall be trained.

<u>NATIONAL</u>	<u>STATES*</u>	<u>INTERNATIONAL</u>			<u>CONSENSUS</u>	<u>NFPA 70E</u>
		<u>ALBERTA</u>	<u>GERMANY</u>	<u>BRITAIN</u>	<u>ANSI</u>	<u>Part II</u>
		<u>CANADA</u>	<u>[46]</u>	<u>[71]</u>	<u>Z244.1-1982</u>	<u>[54]</u>
		<u>[92]</u>			<u>[5]</u>	
Incomplete and inconsistent. Some sections require provisions for lock-out only while other sections require physical lockout or tagout but do not require verification, procedures, or training.	Essentially identical to the national OSHA standard except in California. California requires that energy be isolated, blocked, dissipated, secured, a warning be posted, and verified. Procedures shall be documented and personnel shall be trained.	Energy shall be isolated, blocked, dissipated, secured against accidental movement or use a physical means on the power control, a warning tag, and verified.	Energy shall be isolated, blocked, and dissipated. Unauthorized erroneous or unexpected initiation of hazardous movements shall be avoided.	Document a written "permit to work" system procedure and train personnel in safe practices.	Energy sources shall be blocked, dissipated, secured by lockout devices or tag-out devices, and verified. Procedures shall be documented and personnel shall be trained.	Energy sources shall be blocked, dissipated, secured by tag only, or lock only, or no locks or tags, and verified. Procedures shall be documented and personnel shall be trained.

\*States reviewed: AL, AZ, CA, HI, IN, IA, KY, MD, MI, MN, NC, NV, OR, SC, TN, VT, WA, and WY.



The existing British Code of Practice relies on the human element to follow a documented "permit to work" system for performing maintenance. It closely parallels the recommended guidelines, and relies on the documented system to serve as a record of all the foreseeable hazards which have been considered in advance. It also relies heavily on supervision to see that the system operates properly.

The Consensus Standards are similar to the recommended guidelines. They provide the options of (1) securing the point(s) of control by lockout or tagout devices or (2) having no locks or tags, provided other requirements are met. These standards, however, do not allow the option of having a person remain at the point(s) of control to protect against unauthorized actuation of the machine or process during maintenance and servicing. Also, the standards do not cover the broad spectrum of hazards as do the recommended guidelines.

#### National Standards

The existing national standards as shown in Table C-4 are not uniform in their coverage. Inconsistencies in the requirements exist between industries and between equipment within the same industry. Some sections of the General Industry Standards imply locking out or tagging out energy rather than specifying that lockouts or tagouts be performed. Sections of the standard covering industries or equipment requiring provisions for only locking out or tagging out energy are: overhead and gantry cranes; woodworking machinery; mechanical power presses; certain forging machines; certain pulp, paper, and paperboard mills; textiles; certain bakery equipment; and certain sawmill equipment. Other sections of the General Industry Standard are more positive and explicit in their coverage in that they specify that lockouts or tagouts shall be utilized. Industries or equipment in this category are: certain forging machines; certain pulp, paper, and paperboard mill equipment; certain bakery equipment; certain sawmill equipment; and telecommunications systems. The Construction Standard is also inconsistent in its requirements. Sections of the standard covering industries or equipment wherein provisions for only locking out or tagging out energy are specified consist of: woodworking tools, base-mounted drum hoists, motor vehicles, and pile-driving equipment. Sections of the Construction Standard covering industries or equipment which specify that lockouts or tagouts be performed are: general contractor machinery, electrical circuits, conveyors, construction equipment such as bulldozers and end-loaders, electric blasting equipment, power transmission and distribution lines and equipment, and electrical substations. The existing national standards have only limited effectiveness because of the lack of uniformity (lockouts for some industries and only provisions for lockouts for others) and because they are written only for specific industries. The existing General Industry and Construction Standards related to this subject, as compiled by OSHA, are contained in Appendix D.

#### State Standards

The existing state standards (Table C-5), with the exception of those for California and Michigan, are essentially identical to the national standards. California has horizontal standards which recommend isolating or blocking energy sources; dissipating or blocking stored energy that constitutes a personnel hazard; using physical means or devices to secure the point of control

TABLE C-4

## LOCKOUT AND TAGOUT NATIONAL STANDARDS

GENERAL INDUSTRY, OSHA SAFETY AND HEALTH STANDARDS  
(29 CFR 1910)

29 CFR PART 1926, OSHA SAFETY AND HEALTH REGULATIONS  
CONSTRUCTION, FEDERAL REGISTER

These standards are written for specific industries only. The following sections of the standards make provisions for locking out or tagging out energy.

1910.145(f)(1)(i)	261(e)(12)(iii)
145(f)(3)(iii)	261(e)(13)
179(g)(5)(i)	261(f)(6)(i)
179(g)(5)(ii)	261(g)(4)(ii)
179(g)(5)(iii)	261(g)(15)(i)
179(l)(2)(i)(c)	261(g)(16)(i)
181(f)(2)(i)(c)	261(g)(19)(iii)
213(a)(10)	261(g)(21)
213(b)(5)	261(j)(1)(iii)
217(b)(8)(i)	261(j)(4)(iii)
217(d)(9)(iv)	261(j)(5)(iii)
218(a)(3)(iii)	261(j)(6)(i)
218(a)(3)(iv)	261(k)(2)(ii)
218(d)(2)	262(c)(1)
218(e)(1)(ii)	262(n)(2)
218(f)(1)	262(p)(1)
218(f)(2)	262(q)(2)
218(g)(1)	263(k)(12)(i)
218(h)(2)	263(l)(3)(iii)(b)
218(h)(5)	263(l)(8)(iii)
218(i)(1)	265(c)(12)(v)
218(i)(2)	265(c)(13)
218(j)(1)	265(c)(26)(iii)
252(c)(1)(i)	265(c)(26)(v)
261(b)(4)	265(e)(1)(iv)
261(b)(5)	268(l)(2)
261(e)(2)	268(m)(7)(i)
261(e)(10)	

These regulations are written for general use equipment, specific purpose equipment, and special systems with limited applicability. The following sections of the regulations make provisions for locking out or tagging out energy.

1926.20(b)(3)
200(h)(1)
200(h)(2)
304(a)
400(a)
555(a)(7)
601(b)(10)
906(j)
906(l)
950(d)(1)(ii)(b)
950(d)(2)

TABLE C-5

STATE STANDARDS

STATE OF CALIFORNIA STANDARDS

STANDARDS FROM OTHER STATES  
AND THE TERRITORY OF PUERTO RICO

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These standards parallel the recommended guidelines.

The standards are written for electrical equipment or systems, prime movers, machinery, and equipment in general.

These standards are written for specific industries only and are not horizontal standards. They are essentially identical to and parallel to the 29 CFR 1910 national standards.

The Michigan standards closely parallel the recommended guidelines except they do not include verification prior to starting maintenance.

to prevent unauthorized persons from reenergizing the system; using warning tags to caution personnel that energy has been isolated and the reason for isolation; verifying that isolation of energy has been effective; verifying that personnel have cleared the area prior to reenergizing the machine or system; documenting procedures; and ensuring that personnel who implement the criteria have been adequately trained to thoroughly understand the procedures.

The Michigan standards closely parallel the recommended guidelines except Michigan does not include verification that blocking, isolating, and dissipating hazardous energy have been effected before starting maintenance.

#### International Standards

International standards from Canada, Germany, and Britain (summarized in Table C-6) parallel portions of the recommended criteria. The Alberta, Canada, regulations for machinery and equipment state that no maintenance or repairs shall be carried out until the machinery or equipment has been shut down and secured against accidental movement or the power control devices have been locked out in an inoperative mode by the installation of lockout devices and warning tags. Dissipation of stored energy, verification that isolation and dissipation have been effected prior to starting maintenance, and verification that upon completion of maintenance, personnel are clear of the danger points before the machine or equipment is reenergized are also included as requirements.

The German specifications for setup, troubleshooting, and maintenance of power-driven equipment state that these tasks must only be performed when: (1) The hazardous movements are brought to a halt; (2) the initiation of hazardous movements as a consequence of stored power or energy is prevented; and (3) unauthorized, erroneous, or unexpected initiation of hazardous movements is avoided by some adequate means.

The British Code of Practice for Safeguarding of Machinery states that effective control of hazards during maintenance can be achieved by having a written "permit to work" system. Such a system must clearly identify the hazards and document the practices to be followed, precautions to be taken, and responsibilities of the workers and of management. The code of practice also calls for adequate training of workers and supervision in safe systems of work and lockout systems for maintenance operation.

#### Consensus Standards

The ANSI and NFPA standards (Table C-7) establish requirements and procedures for lockout/tagout of energy sources for stationary machines and equipment and for electrical circuits and electrical equipment, respectively. These standards require (1) that energy sources be isolated or blocked for maintenance, (2) that stored energy be dissipated prior to beginning maintenance, (3) that physical means or devices be used to secure the energy sources, (4) verification that the energy sources have been isolated prior to starting work, (5) verification that all personnel are clear of hazards before reenergizing the machines or systems, (6) assurance that the procedures for lockout/tagout have been documented, and (7) that personnel have been adequately trained to understand and implement the recommended guidelines.

Applicability of the ANSI standard is limited to unexpected energization, startup, or release of stored energy of equipment or process. The NFPA standard does not have such a limitation but covers only electrical energy. The recommended guidelines are applicable for all phases of maintenance and servicing.

TABLE C-6

INTERNATIONAL STANDARDS

OCCUPATIONAL HEALTH AND SAFETY REGULATIONS, ALBERTA, CANADA [92]	ACCIDENT PREVENTION SPECIFICATION (DRAFT) "POWER-DRIVEN EQUIPMENT," GERMANY [46]	SAFEGUARDING OF MACHINERY, BSI CODE OF PRACTICE, BRITAIN [71]
<p>These regulations contain both horizontal and vertical standards for specific equipment and a limited number of specific industries.</p>	<p>This specification parallels certain sections of the recommended guidelines.*</p>	<p>This standard states that maintenance hazards can be effectively controlled by documenting a "permit to work" system identifying hazards and precautions to be taken, defining practices to be followed and defining worker and management responsibilities for maintenance. Adequate training of workers and supervision in the application of safe work practices during maintenance is also a requirement.</p>
<p>This regulation parallels the recommended guidelines.*</p>	<p>*"Setup, troubleshooting or maintenance tasks must be performed only in the area provided for this purpose when unauthorized, erroneous, or unexpected initiation of hazardous movements is avoided." The specification does not describe how hazardous movements shall be avoided.</p>	
<p>*"When machinery or equipment is shut down for maintenance or repairs, no work shall be carried out until all parts, extensions and attachments thereto have been secured against accidental movement <u>or</u> the power control devices have been locked out in an inoperative position with a supplemental tag which describes the work to be performed and the name of the worker responsible for the installation of the lockout device."</p>		

TABLE C-7

CONSENSUS STANDARDS

ANSI Z244.1-1982 SAFETY STANDARD FOR  
THE LOCKOUT/TAGOUT OF ENERGY SOURCES  
[5]

NFPA 70E PART II LOCKOUT SAFETY  
RELATED WORK PRACTICES  
[54]

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This standard parallels the recommended guidelines.

This standard allows that either lockout devices shall be attached to hold the energy isolating devices in a safe position or tagout devices shall be attached to forbid the operation of the energy isolating devices.

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These safety related work practices cover procedures for employees who work with electric circuits and equipment. These procedures are essentially identical to the recommended guidelines.

This standard allows the use of tags only when it is not feasible to apply locks to effect lockout. Where circuits or equipment are deenergized for minor maintenance, servicing, adjusting, etc., the work shall be permitted to be performed without the placement of locks or tags on the disconnecting device.