

Fortress Interlocks

Steel Applications

Electric Arc Furnace:

Cranes (Blast Furnaces):

Converter Maintenance Lift:

Desulphurisation Pit:

Rabblers:

Ladle Furnace:

Continuous Casting Machine:

Continuous Billet Caster:

Cranes (Slab Caster Mill):

Welder:

Accumulator Lines:

Cold Rolling Mill & Slitting Line:

Inspection Chamber:

Coil Conveyor:

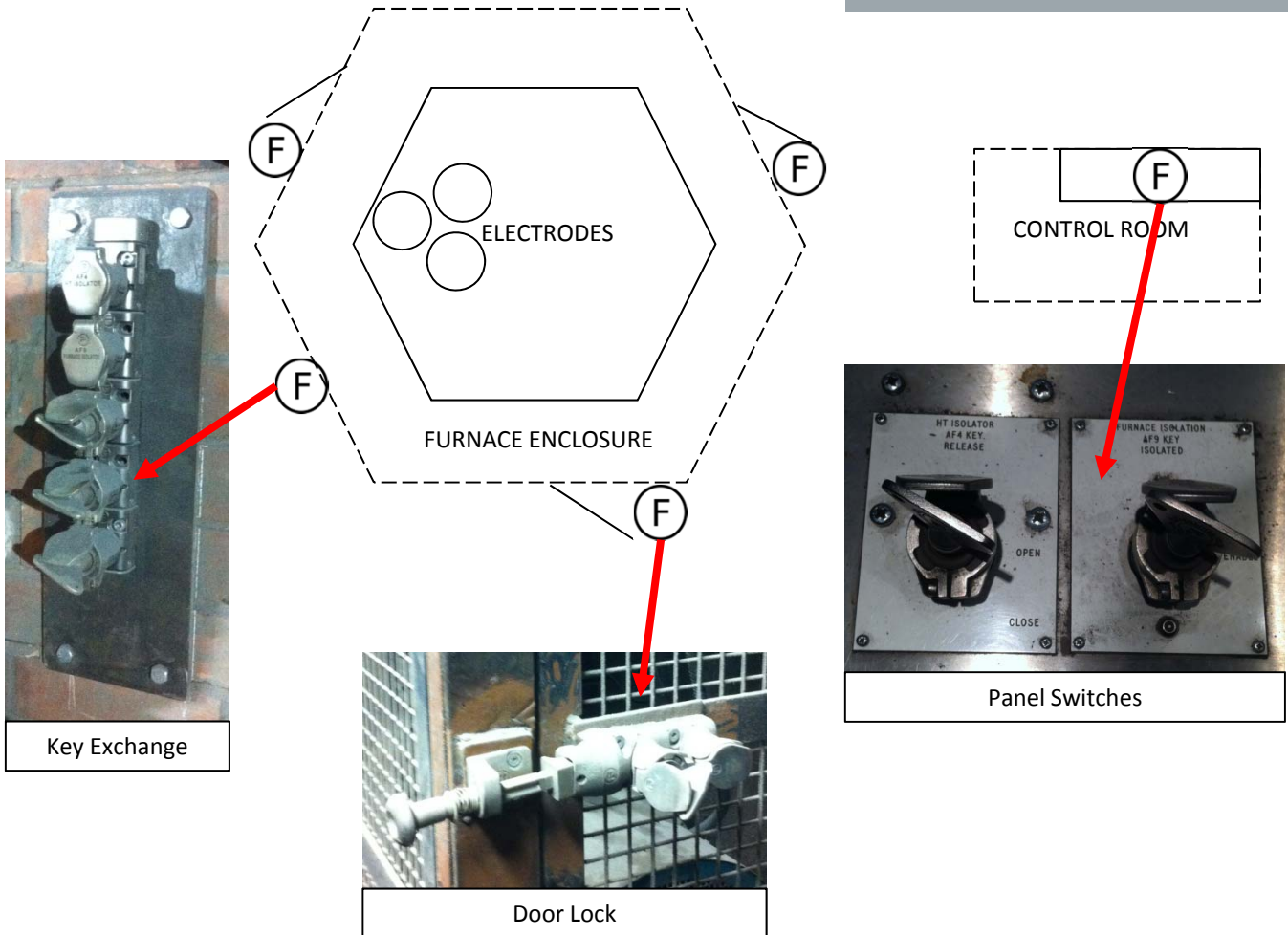
Rail Infeeder Line:

Rail Processing Machinery:

Rail Shop Cranes:

STEEL INDUSTRY

ELECTRIC ARC FURNACE



DANGER

Due to the heat and electricity involved in the process of steelmaking, the danger area surrounding the electric arc furnace is surrounded by guarding. Maintenance staff occasionally need to enter the enclosure but they should not be able to do this whilst there is power running to the furnace.

FUNCTION OF EQUIPMENT

An electric arc furnace is a refractory-lined vessel with a retractable roof through which electrodes are inserted. It functions to convert scrap metal into molten steel using high voltages whilst oxygen is blown into the scrap.

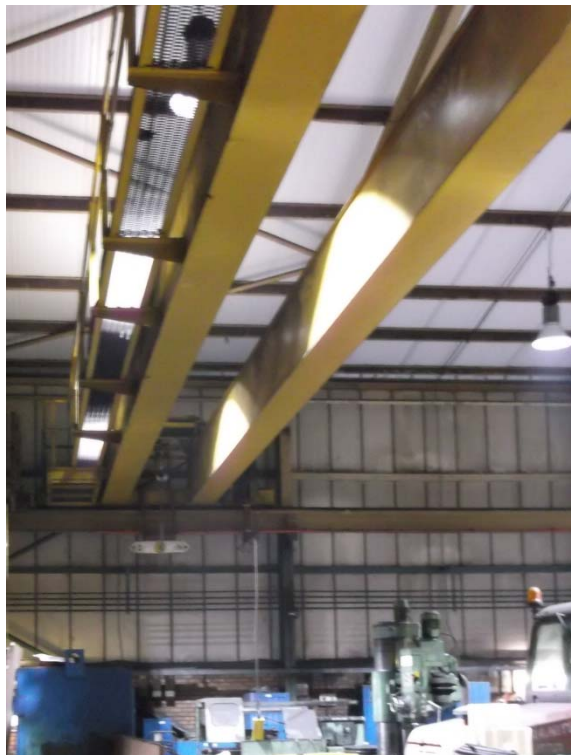
FORTRESS PRODUCT

mGard; SS1-CLIS-A06322DO24-B, S1-CLIS-A06322-B, XM5-CLIS-H & DM2-CLIS-H

FORTRESS SOLUTION

When staff want to enter the furnace enclosure, they press request-to-enter. When the enclosure is safe to enter, they extract both the panel keys, one which isolates the power and one the controls. These 2 keys are entered into the exchange box, which releases 3 access keys, one for each gate. The access keys are put into the gate locks, which releases the gate and the safety key is taken into the enclosure with the personnel. The furnace can't be started again until the gates are shut, and the panel keys been released to be reinserted into the control panel.

OVERHEAD GANTRY



POWER
ISOLAT
-ION

F
ACCESS
BOX



C
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OVERHEAD GANTRY

DANGER

In the blast furnace shop, there are 17 pendant controlled cranes which are used for maintenance. These cranes are at various positions around the shop, including in the workshop and at the top of the furnace towers. The cranes tend to be used whilst other maintenance operations are in progress and there is a danger that the crane operator will move his crane into an area where there are other staff working.

FUNCTION OF EQUIPMENT

The cranes are used to move and position large pieces of equipment needed for maintenance operations.

FORTRESS PRODUCT

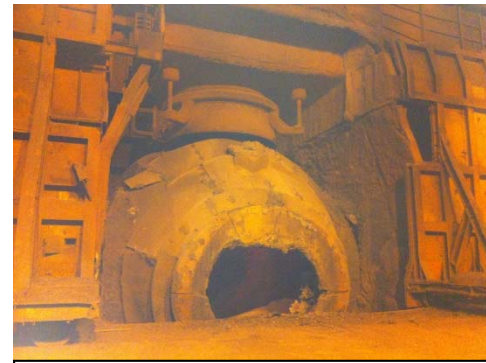
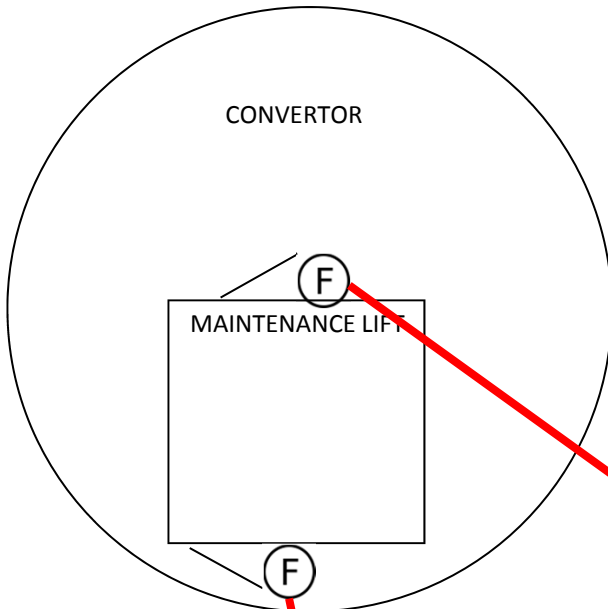
mGard; XM2 in special exchange box

FORTRESS SOLUTION

Each crane in the blast furnace shop has its power isolated and padlocked off and besides the power isolation is a crane access box. To use a crane, the driver opens the box and enters his personal, name tagged yellow key into the interlock. This releases the green key from the stack, attached to which is the padlock key to the power isolation. The padlock is unlocked and the power to the crane can be turned on. The pendant used to direct the crane is stored in the box (not in the above picture though). The green key is simply a means of ensuring the padlock key can only be released by a crane driver. If a coloured padlock is locking the box shut, the driver must contact the PICC (person in charge of cranes). A blue padlock means there's something different from usual in the crane area (scaffolding etc.) and a red padlock means the crane can't be used.

STEEL INDUSTRY

CONVERTER MAINTENANCE LIFT



Converter Being Cleaned



Converter Maintenance Lift



DANGER

If the lift doors are opened before the lift has come to a standstill at the correct position, it presents a danger to workers in the lift and to those working in the vicinity.

FUNCTION OF EQUIPMENT

The converter is around 50ft tall so when it comes to relining it with reflective bricks (every 6 months or so), a lift is needed to position the workers and the raw materials at various positions in the converter.

FORTRESS PRODUCT

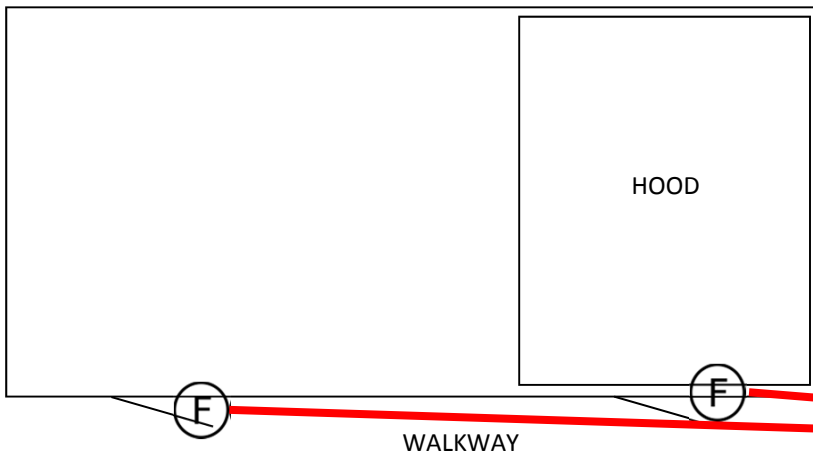
amGard pro; Lok body with tongue actuator; TA2T6SL411

FORTRESS SOLUTION

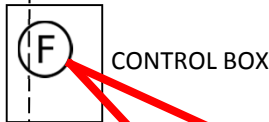
The amGard lok ensures that the lift doors may only be opened at certain programmable positions, when the lift is stationary. At the bottom, both doors may be opened, but at the top, only the east side door can be opened to allow reloading and workers to enter from the platform.

STEEL INDUSTRY

DESULPHURISATION PITS



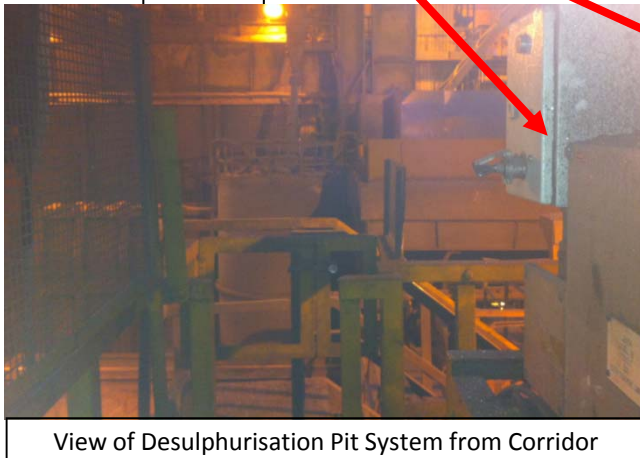
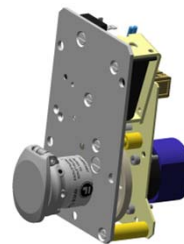
Gate into Desulphurisation Pit



CONTROL BOX



Control Box



View of Desulphurisation Pit System from Corridor

DANGER

The hood is designed to move back and forth from one side of the pit to the other. Therefore, whilst the hood is positioned on one side of the pit, there is a 30 foot drop to the bottom of the pit from the access gates on the other side of the pit .

FUNCTION OF EQUIPMENT

The desulphurisation pits are where lime and magnesium are added to the ladles of molten iron by means of a lance, which is inserted into the ladle, causing the impurities to precipitate and collect on the surface.

FORTRESS PRODUCT

mGard; A DM1 on each gate and a panel mounted SS switch; 2 x DM1-CLIS-A & SS1-CLIS-A02022D024B

FORTRESS SOLUTION

Access is restricted so that only an engineer may gain access to the pits after they have carried out the appropriate procedures in the control box. The engineer is only able to gain access to one of the 2 gates at any point in time, as there is only one key, cut so as it can open either of the DM1's.

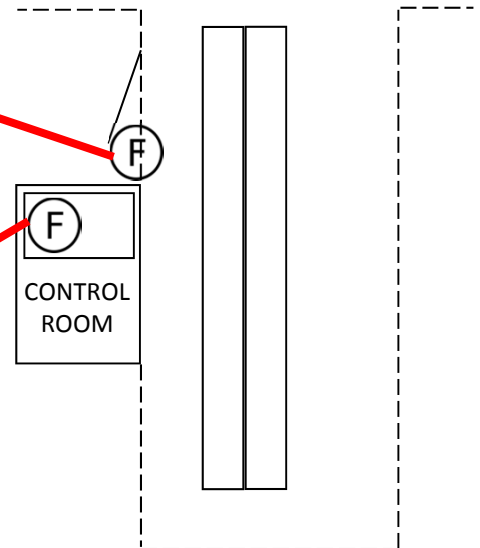


STEEL INDUSTRY

RABBLER



Door Interlock



Rabblers in the Enclosure and Control Room



Rabblers In Action

DANGER

Due to the confined space, it is hazardous for anyone to be present in the rabbler enclosure whilst there is power to it. The rabbler requires both cleaning and maintenance so a solution is required to ensure that access may only be granted to the enclosure once the power to the rabbler has been isolated.

FUNCTION OF EQUIPMENT

The rabbler is a large, operator controlled, metal arm, approximately 25 feet long, which functions to scrape the layer of slag off the top of the tilted ladle. The rabbler can be seen in operation in the above picture.

FORTRESS PRODUCT

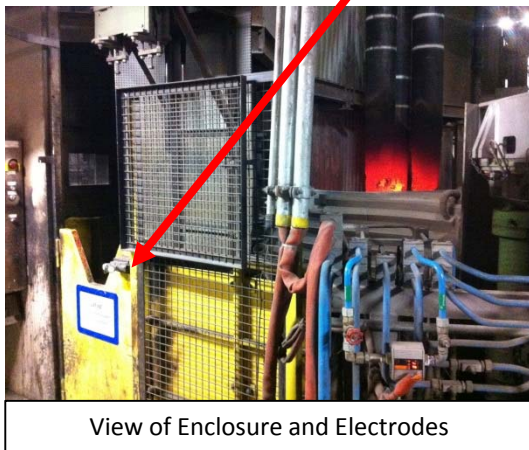
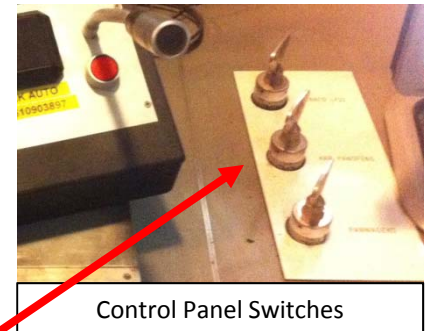
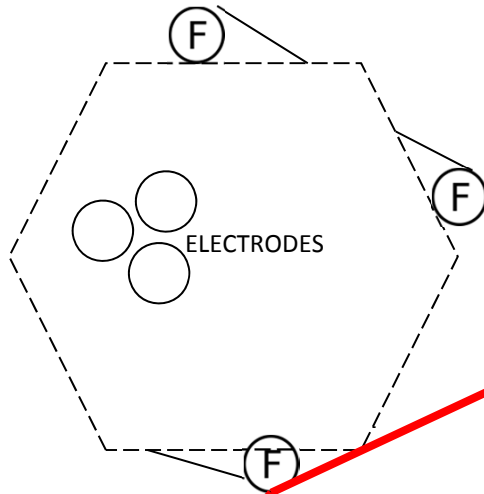
mGard; panel mounted switch and door lock; DMS1-BLBB-H & S-BLBB-A02022

FORTRESS SOLUTION

Removing the key from the panel switch causes the power to the rabbler to be isolated and this key can then be used to open the gatelock, in which it is trapped. This ensures that no-one is able to gain access to the rabbler enclosure whilst power is running to it.

STEEL INDUSTRY

LADLE FURNACE



DANGER

There are 3 access gates into the electrode enclosures, which must remain shut whilst a ladle is being processed. When substances are being added to the ladle and when the electrodes are lowered, molten metal is blown into the surrounding enclosure. The access gates are in the operators blind-spots and therefore there is the danger that maintenance staff who enter through these gates may be trapped in when the operator initiates the process.

FUNCTION OF EQUIPMENT

This ladle furnace is where the alloying materials are added to the ladles of molten steel. The ladle is delivered to the furnace by an overhead crane which places it underneath the electrodes and lances ready for processing.

FORTRESS PRODUCT

mGard; Door locks (DM2-CLIS-S), Control Panel Switches (S-CLIN-A02040), Exchange Boxes (XM4-CLIS, XM5-CLIS & XM6-CLIS)

FORTRESS SOLUTION

To enter the enclosure, the personnel extract the key from the control panel which isolates the power to the ladle furnace. This is then entered into the exchange box and every member of the team who will enter the enclosure then takes a key, the panel key remains trapped. The supervisor uses their key to open the DM1 and takes the safety key (every other person retains their exchange box key). When the team has finished, the supervisor is the last one out and locks the door, exchanging his safety key for the exchange box key. The access key will only be released once every key has been put back into the stack and can then be put back in the control panel to restart the process.



STEEL INDUSTRY

CONTINUOUS SLAB CASTER



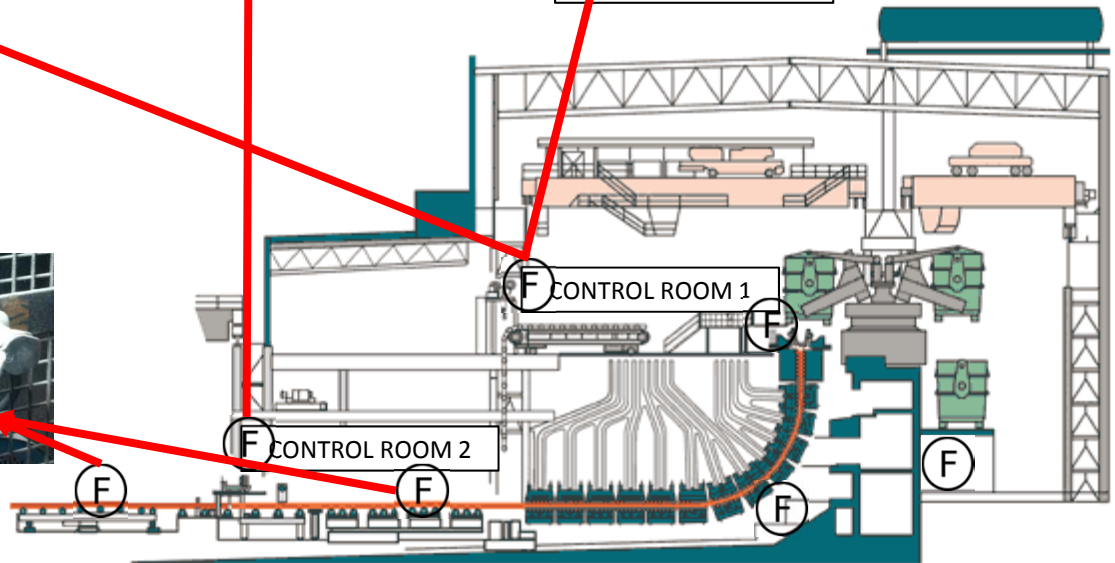
Exchange Boxes (1)



Power Maintenance box (2)



Master key (1)



DANGER

The continuous casting machine has molten metal passing through it which is processed by many moving parts. Under normal operations, there is no need to enter the caster, so access is usually only for maintenance. As the machine is so large, with numerous blind-spots and 2 control rooms, the danger is that an operator will start the machine, unaware that an engineer is working on parts of the machine.

FUNCTION OF EQUIPMENT

This continuous slab caster solidifies molten metal into semi-finished steel slabs. The tundish distributes the molten steel to open based moulds that provide the shape. Final solidification and cooling of the strands takes place as they pass through the water cooled roller segments.

FORTRESS PRODUCT

mGard; master key, 2 exchange boxes and multiple door locks; SS1-CLIS-A02022D024B, DM2-CLIS-H and specials

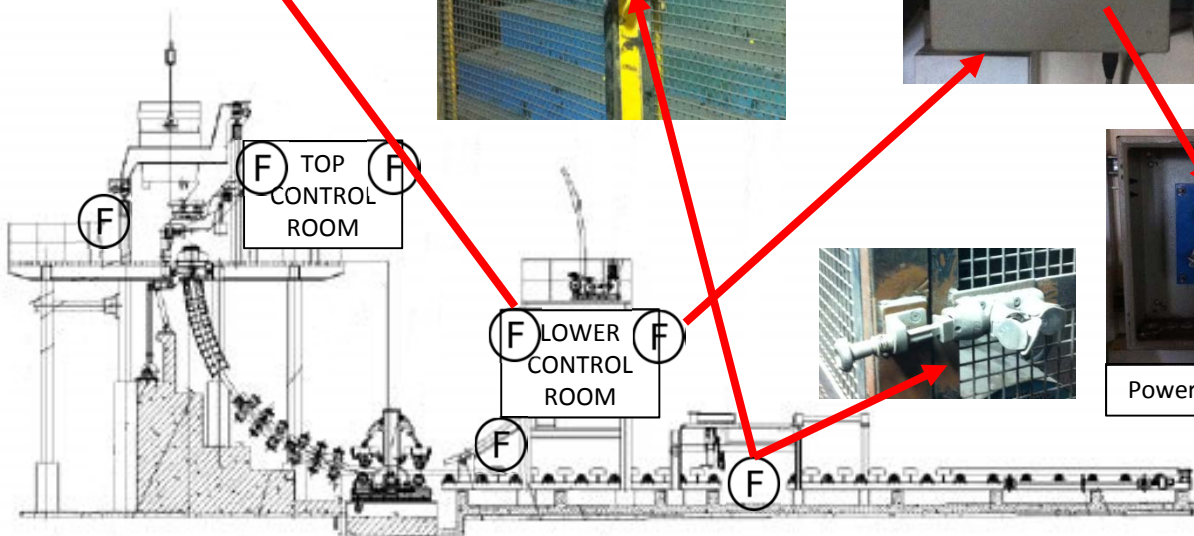
FORTRESS SOLUTION

To enter the caster, personnel press request-to-enter on the panel in the top control room and the machine enters a rundown cycle. When the machine has halted, the master key can be removed. This is entered into the exchange box to release access keys to zones 1,2 and 3. Each key may only be used on the gates in its zone (there are up to 5 gates per zone, one gate open at once). In the lower control room, the master key can only be released by pressing request-to-enter in the top control room. This master key is put into the lower room exchange box to release keys to zones 4 and 5. The power maintenance box can only be opened by qualified engineers who have the padlock key. The master key is inserted and releases zone access keys, to allow access whilst some power remains. The access keys are used to open the gate locks and the maintenance staff take the safety key into the machine with them.



STEEL INDUSTRY

CONTINUOUS BILLET CASTER



DANGER

The continuous casting machine has molten metal passing through it which is processed by many moving parts. Under normal operations, there is no need to enter the caster, so access is usually only for maintenance. As the machine is so large, with numerous blind-spots and 2 control rooms, the danger is that an operator will start the machine, unaware that an engineer is working on parts of the machine.

FUNCTION OF EQUIPMENT

This continuous billet caster solidifies molten metal into semi-finished steel billets. The tundish distributes the molten steel to open based moulds that provide the shape. Final solidification and cooling of the strands takes place as they pass through the water cooled roller segments

FORTRESS PRODUCT

mGard; master key, 2 exchange boxes and multiple door locks; SS1-CLIN-A02022D024B, DM2-CLIS-H and specials

FORTRESS SOLUTION

There are 2 control rooms for the continuous billet caster, one top and one lower. The lower one is the main control room as this is where the most access is required. There are 3 zones each with 4 gates. When maintenance staff need to enter, they press request-to-enter and when safe, the panel key is released (the top control room panel key is also released). This is put into the exchange box (lower room has keys for 2 zones, top room has 1) and the access keys are released. There are 4 access keys for each zone, so all gates may be accessed at the same time and the safety key is taken in by whoever opens the gate. Sometimes, maintenance need power running whilst in the area. There is a second key exchange box padlocked shut and only some staff have the padlock key. If the panel key is put into the second exchange box instead, access keys are released for the zones, but some power remains.



STEEL INDUSTRY

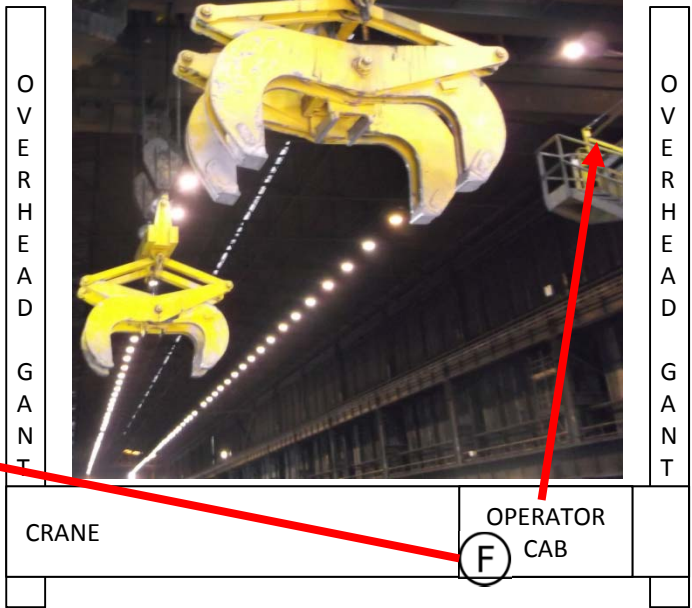
SLAB CASTER MILL CRANES



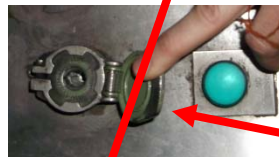
Crane Unavailable



Control Room Mounted Boxes



Crane in Use



F
CONTROL ROOM

DANGER

The crane operators sit in cabs hanging besides the cranes and direct them from there. There is limited visibility from these cabs and there is a danger that the crane operator will not be aware of other personnel working in the surrounding area when he is operating his crane. There are 8 cranes in the slab casting mill, so a way of controlling which cranes may be operated is needed.

FUNCTION OF EQUIPMENT

The cranes in the slab casting mill are used to pick up slabs and place them in cooling bays or on train cars.

FORTRESS PRODUCT

mGard; Special exchange boxes and S-CLIS-A02022-B

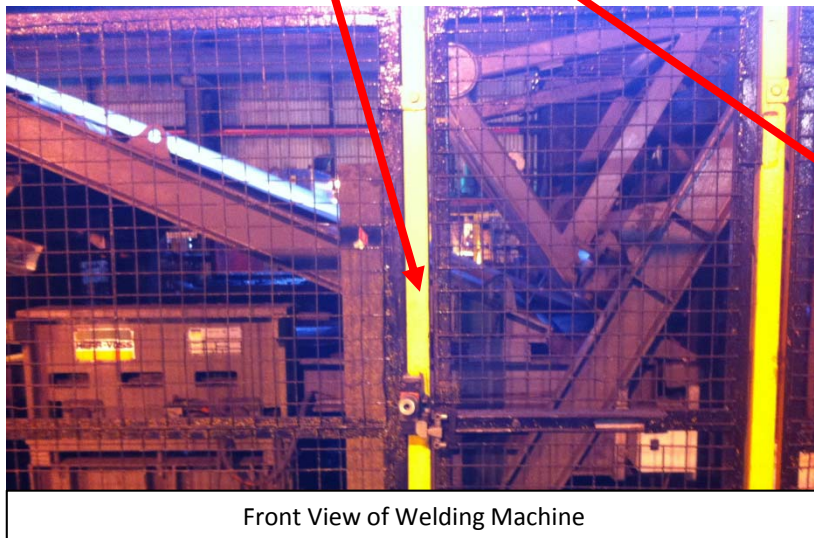
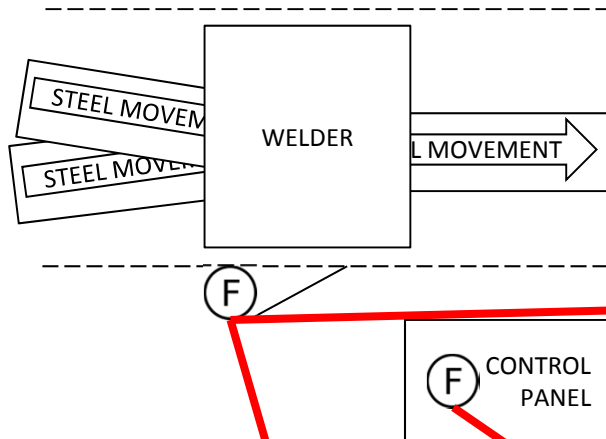
FORTRESS SOLUTION

In the control room, there are 8 crane key boxes fixed to the wall. To operate a crane, the driver inserts his yellow key into the box and extracts the green key. This key is taken with them up to the cab and inserted into the panel switch, which grants access to start operating the crane. There is a danger slide bar on each box can be padlocked in position; red means crane is unavailable, green means available and blue means contact supervisor. Some boxes have 2 yellow locks so a second driver can insert a key and go up to the cab to take over. When the crane is unavailable (red), the yellow locks may be padlocked shut so drivers can't insert their yellow keys.



STEEL INDUSTRY

WELDER



Front View of Welding Machine

DANGER

The welding machine is surrounded by guarding as there is moving sheet metal and heavy machinery. Maintenance personnel need to gain access to the enclosure occasionally and a system is required that ensures that the line is at a standstill before they can enter.

FUNCTION OF EQUIPMENT

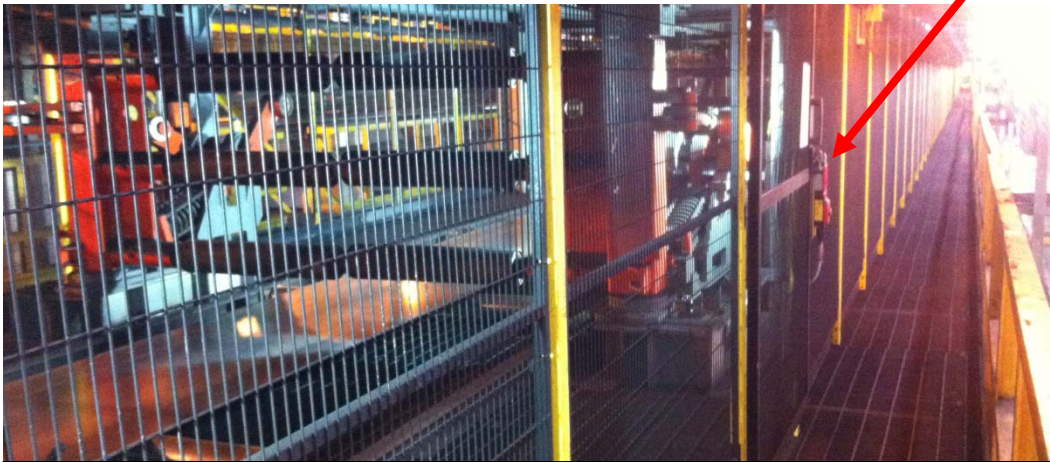
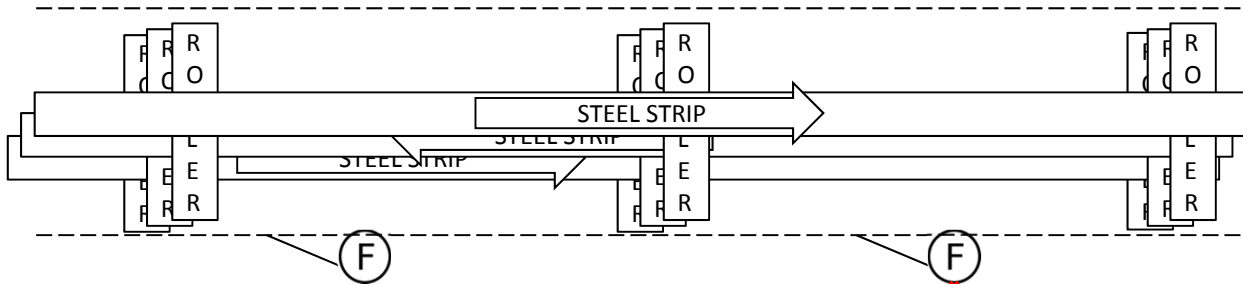
The welder is used to join together the end of one uncoiled sheet to the start of the next uncoiled sheet.

FORTRESS PRODUCT

amGard and mGard; door lock and panel mounted switch; ATA1FOOT-CLIN & SS1-CLIS-A02022A110B

FORTRESS SOLUTION

When an engineer wants to enter the welding enclosure, they press request-to-enter on the control panel, which causes the machine to enter a rundown cycle. When the machine is safe, the solenoid is energised and the key may be extracted and used to open the door lock. The machine can't be started until the key has been returned to the panel.



View Along the Accumulator Line



DANGER

The steel sheet is moving quickly through the rollers and due to the length of the line (300m) from any point on the line, it is difficult to see if anyone is in the enclosure, working on the lines. The danger is that an engineer will be working on the line at one end and someone at the other end will start the line assuming it is safe.

FUNCTION OF EQUIPMENT

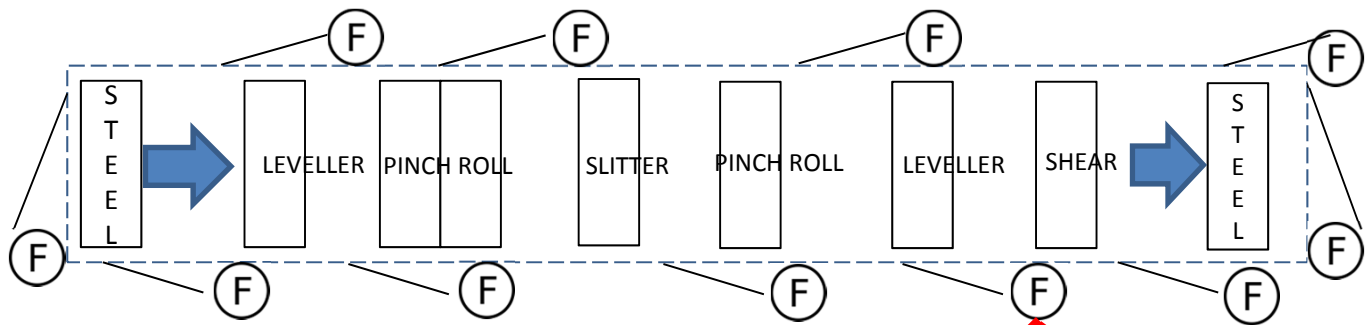
The accumulator is a part of the pickling lines in the cold rolling mill. The steel sheet is run backwards and forwards through a series of rollers to create an accumulation of sheet that feeds continuous processes further down the line.

FORTRESS PRODUCT

amGard; Lok body with option pod; ATLOK024024PODB

FORTRESS SOLUTION

To get onto the line, the personnel press the request-to-enter button on the option pod at each gate which causes the line to enter the rundown cycle. When the line is safe to enter, the solenoid is energised and the door may be opened. The line will not start again until all of the doors are locked again. This product need to cope with the heavy vibrations caused by the moving steel sheets and rollers.



Side View of Cold Rolling Mill



Interlock Mounted on Enclosure Gate



20 year old interlock

DANGER

There are a number of dangerous machines on the cold rolling mill and slitting line and therefore the entire area is surrounded by fencing. Staff need to enter the enclosure every 2 hours or so to carry out inspections and maintenance work. A system is required which isolates the power to the machines in the area before someone can open the gate to the enclosure.

FUNCTION OF EQUIPMENT

The cold rolling mill functions to reduce the thickness of the steel by passing the sheet through a series of pinch rolls and flatteners which apply pressure to make the sheet thinner whilst maintaining its shape and width. The steel then passes through the slitting line where it is cut into uniform lengths and stacked.

FORTRESS PRODUCT

amGard; Lok body with handle actuator; AMLOK024024 & AMGARD4

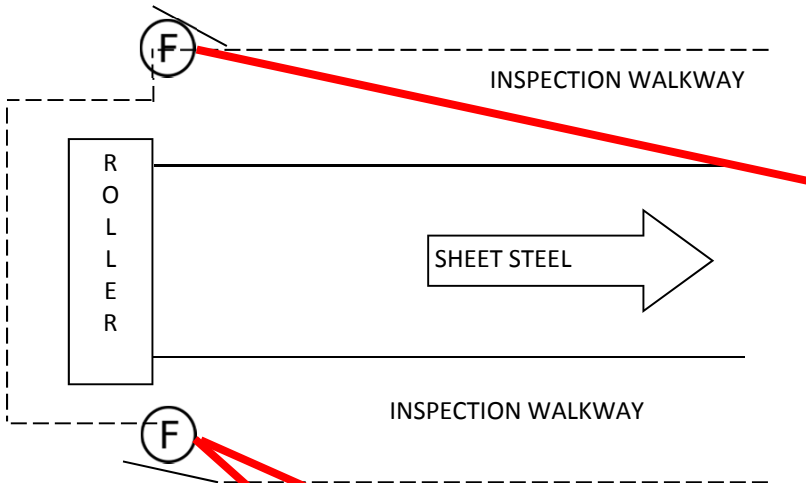
FORTRESS SOLUTION

When personnel want to enter the enclosure, they press request-to-enter on the control panel for the specific area. Once the machines in that area have fully stopped, the solenoid is energised and the gate may be opened. Opening the interlock breaks the safety contacts and means that the machines in that area of the line may not be restarted until the actuator is replaced in the head. The previous Fortress locks have been installed for around 20 years.

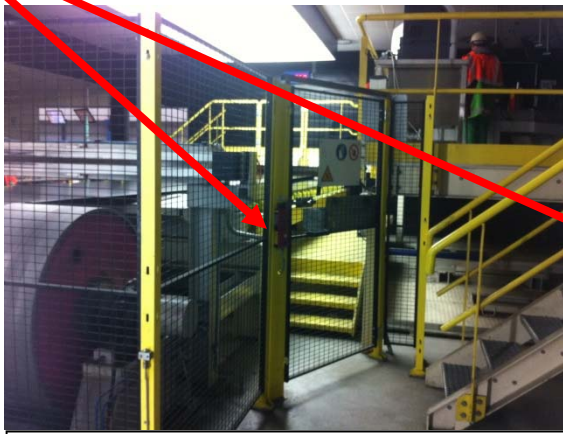


STEEL INDUSTRY

INSPECTION CHAMBER



Top View of Rollers



Inspection Chamber and Walkway



DANGER

The sheets of steel which are coming off the rollers must be inspected regularly for thickness, surface quality and imperfections. The rollers along which the sheet steel is passed are in a guarded enclosure so for the inspections, an operator must enter this enclosure. A system is therefore required which ensures that the power to the rollers is isolated whilst the operator is in the enclosure, so that the steel sheets are stationary during this period.

FUNCTION OF EQUIPMENT

The inspection chamber is at the end of the buffer zone. This is where the sheet steel is run through a series of rollers so that the machines downstream can be permanently fed, even when the upstream machines are stopped for several minutes at a time, for inspection and maintenance.

FORTRESS PRODUCT

amGard; Lok body with slide-bar and option pod; SBN-LOK024024-PODB

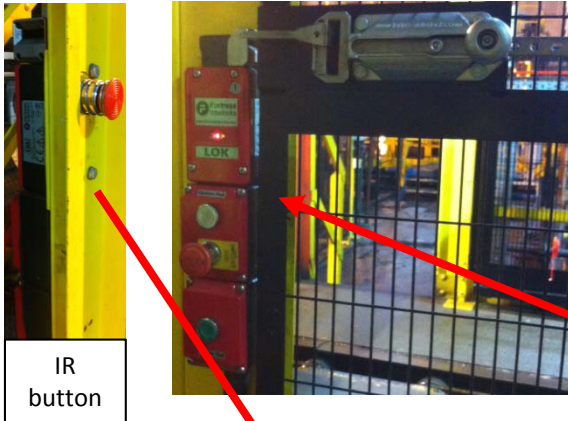
FORTRESS SOLUTION

Access is requested by pushing the entry button. When the machines have stopped, the led will light to indicate the machine is safe to enter and the door may be opened. When the door is shut again and the slide-bar shot back across, the request-to-enter is removed and the machines may be started again.

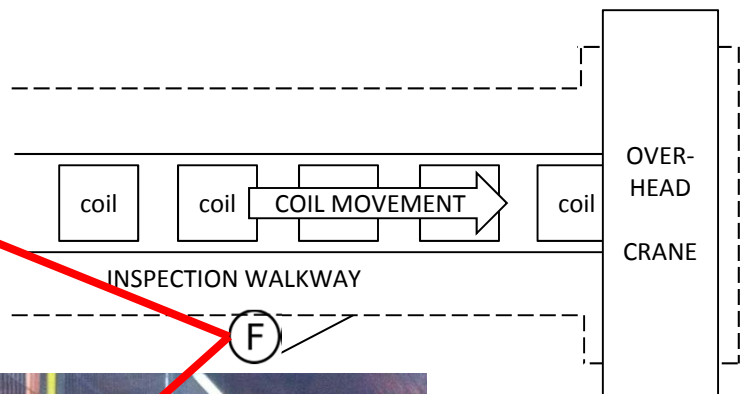


STEEL INDUSTRY

COIL CONVEYOR



IR button



DANGER

The steel coils are moved to the end of the shop by conveyors and at this stage, operators examine the edges of the coils using a handheld device and to do this, the operators need to enter the guarded enclosure around 20 times per hour. The danger is in operators gaining access to the conveyor enclosure whilst the lines are still moving and also, as the coils are large, that someone may close the door and start the line whilst an operator is in the enclosure.

FUNCTION OF EQUIPMENT

At the end of the pickling lines, the steel is re-coiled and the coils are transported to the end of the shop by the conveyors, where the coils are taken away for further processing or sale.

FORTRESS PRODUCT

amGard; Lok body with slide-bar, option pod, emergency stop and internal release; SBNLOK024024IRBX***

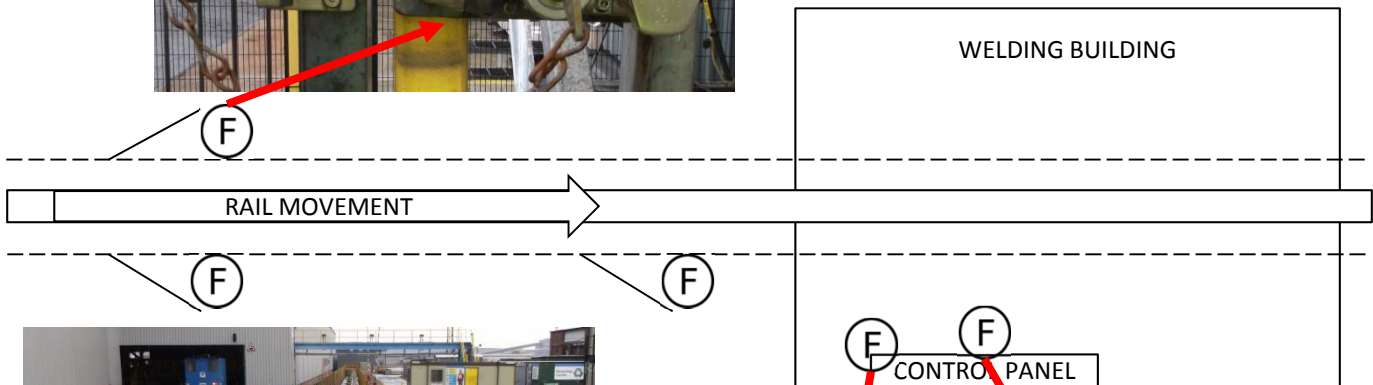
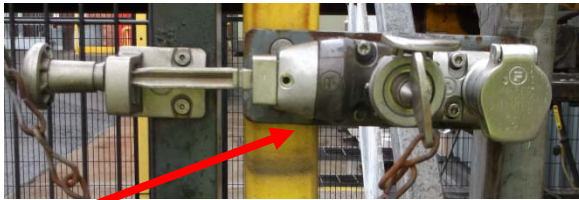
FORTRESS SOLUTION

When an operator wants to enter the enclosure, they press the white request-to-enter. When the conveyor has stopped, the solenoid is energised and the slide-bar may be opened, causing the red LED to illuminate. In the event that someone traps an operator in the enclosure and starts the line, there is an internal release button to trigger an emergency stop and an external emergency stop to open the door. To restart the conveyor, the door must be locked and the green pushbutton pressed.



STEEL INDUSTRY

RAIL INFEEDEER LINE



DANGER

In the rail shop, sections of rail are welded together to form longer sections. The rails are travel down a long line and pass through a number of machines (brushing, grinding, welding and saw machines) which process the rails to make them suitable for use. The entire length of line is enclosed by guarding but staff need to enter for maintenance. As the line is so long, there is a danger that staff in the enclosure could be overlooked when the line is started.

FUNCTION OF EQUIPMENT

The infeder lines functions to supply the welding machines with a continuous supply of short rail sections of rail.

FORTRESS PRODUCT

mGard; SS1-CLIN-A02022-D-24B, XM3-CLIS & DM2-CLIS-H

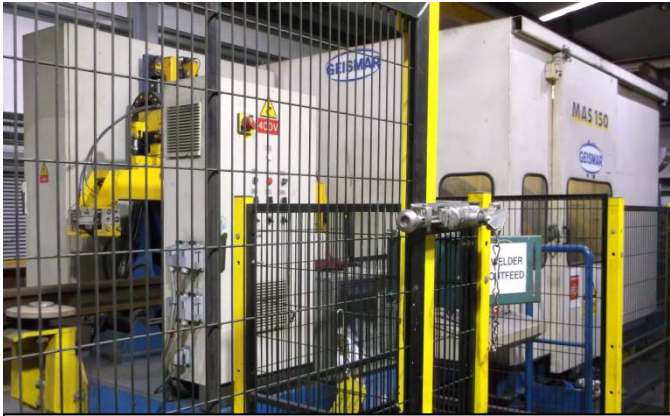
FORTRESS SOLUTION

When staff want to enter the infeder area, they shut off the power to the line by turning the control panel key. This key is then put into a key exchange box to release 2 access keys, which may be used to open any 2 of the numerous gates onto the line at once. The control panel key can't be removed (so the line can't be restarted) until both of the access keys have been returned to the stack.

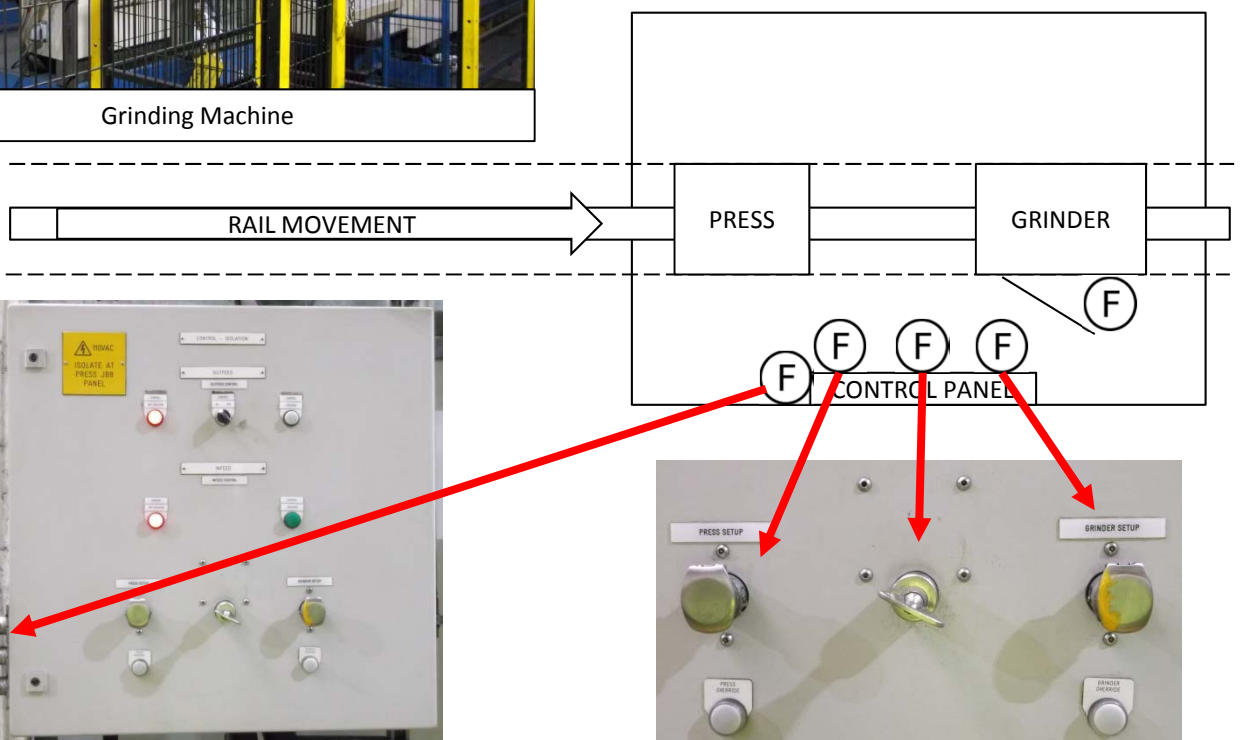


STEEL INDUSTRY

RAIL PROCESSING MACHINERY



Grinding Machine



DANGER

The machines in the rail processing shop are surrounded by guarding and can't be accessed when running. The operators occasionally need to make changes to the setup of the machines so they need a way of putting the machines into a different operating mode.

FUNCTION OF EQUIPMENT

The rails are passed through a number of machines which perform various operations on the lengths (grinding, pressing, brushing, welding and cutting).

FORTRESS PRODUCT

mGard; 3 panel switches; SS1-CLIN-A02022D024-B & 2 x S-CLIS-A02022-B

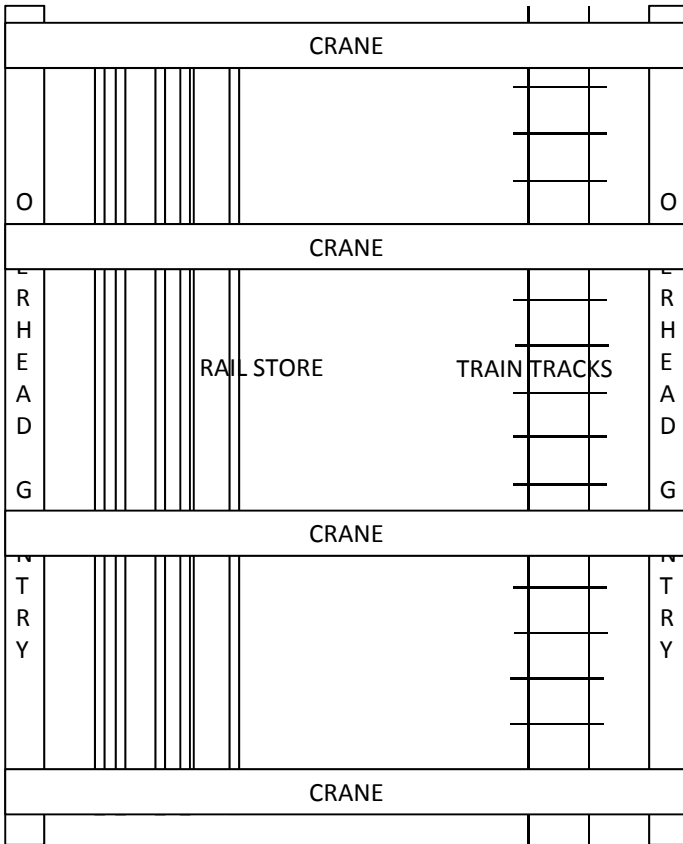
FORTRESS SOLUTION

When the operator wants to change the setup of the machines, they extract the control panel key and enter it into the panel switch for the machine which they want to setup. This allows the operator to make the required changes to the machine setup without entering the enclosure. The gate lock is part of the line entry system, which uses the same control panel key, which is entered into the key exchange box rather than the other panel switches.



STEEL INDUSTRY

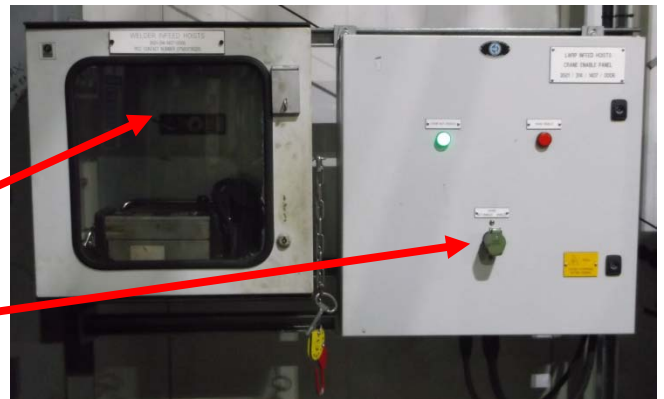
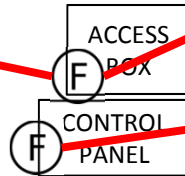
RAIL SHOP CRANES



Rail Infeed Storage Yard



Crane in Use



Crane Not in Use

DANGER

At both the start and the end of the rail shop line there are storage areas, where the rails are stocked before/after processing. The overhead cranes in these areas should only be used by qualified operators so a system is needed which ensures only certain personnel can use the pendant control boxes.

FUNCTION OF EQUIPMENT

The overhead cranes are used to transfer bundles of unprocessed rail sections from the train cars to the stores and to transfer bundles of finished rail sections back onto train cars. The infeed cranes are magnetic and the outfeed cranes are camlock style.

FORTRESS PRODUCT

mGard; XM2 in special exchange box and S-CLIS-A02022-B

FORTRESS SOLUTION

When an operator wants to use the cranes, they unlock the box with the attached key. The pendant is stored inside, but will not operate the cranes in this state. The operator inserts their personal, name tagged yellow key into the exchange box and removes the green key. This green key is inserted into the control panel switch which allows the pendant to operate the cranes.