4.0 FUNCTIONAL DESCRIPTION

The following pages contain the operating philosophy for project no. 4360 as prepared by **ADCL**'s Controls group.

Bale Handling System

FUNCTIONAL DESCRIPTION

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Revision Index

No.	Date	By	Checked	Approved	Comments
00	08/11/2004	SR			Preliminary issue.
01	08/24/2004	JRH			Reviewed & Corrected
02					
03					

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4.0 GENERAL

Advanced Dynamics Corp Ltd. proposal to supply a Bale Handling System.

The system receives stacks of Kraft bales, wired with 5 bales per stack. These bales are destacked automatically and fed through to a Manual Dewiring Station, where the operator removes the wires. The dewired bale advances to a stacker unit, where when 3 bales have been stacked automatically, they continue onto an outfeed conveyor, where the stack is ready to be transferred to the pulper. See section 4.3 for the design specifications.

The following document can be used as a guideline to understand the operating philosophy and related controls.

Please refer to Advanced Dynamics Corp Ltd. mechanical general layout drawing **#BN00-D1-33466** for general information and all equipment locations.

The controls general layout drawing **# ZA00-B8-33621** is to be referred to for more detailed information.

4.1 VOCABULARY

The abbreviations used in the following document relate to the following:

1. **ADCL:** Advanced Dynamics Corp. Ltd.
2. **ECR:** Electrical control room.
3. **VFD:** Variable frequency drive.
4. **FVR:** Full voltage reversing (motor starter).
5. **FVNR:** Full voltage non-reversing (motor starter).
6. **PLC:** Programmable logic controller.
7. **RVDT:** Rotational variable displacement transducer.
8. **LVDT:** Linear variable displacement transducer.
9. **MCR:** Master control relay. This relay enables electrical operation of equipment in dedicated zones. (E-stop)
10. **HPU:** Hydraulic power unit.
11. **FPM:** Feet per minute.
12. **AB:** Allen-Bradley.
13. **I/O:** Input/output.
14. **N/A:** Not applicable.

4.2 SCOPE OF ELECTRICAL SUPPLY

4.2.1 Provided by ADCL

The supply of electrical components will be in accordance to the following, unless specified otherwise:

- All motors will be type "TEFC" with class "F" insulation. Their voltage will be 460Vac, 3 phase, at 60 Hz, with a 1.15 service factor. They will be inverter duty when controlled by a VFD;
- All control signals for field elements will be 24 Vdc or 120Vac for discreet signals, and 4-20mA for analogue signals.

Where applicable, ADCL will pre-wire all control elements (switches, valves...) to terminal strips in junction boxes, in order to simplify cabling from system I/O points to PLC I/O cards.

4.2.1.1 Major Control Hardware/Software

The following list enumerates the major control components included in the ADCL scope of supply:

One NEMA 12 control panel (80PLC1), complete with:

- One Allen-Bradley SLC-500 PLC
- One Allen-Bradley I/O rack complete with all I/O module;
- Allen-Bradley discreet I/O cards (qty as required);
- PLC program for all ADCL supplied equipment based on RSLogix platform;
- Power supply and miscellaneous material (if required).

One NEMA 12 pushbutton station (80PBS1), complete with:

- All sections except Destacker and Infeed Stack Storage Conveyor manual control.
- Manual dewiring interface button in Automatic mode
- E-stop pushbuttons for the whole Bale Handling System.

Note: The 80PBS1 pushbutton station will be installed on a pedestal near the manual dewiring station. This unit will be shipped separately.

One NEMA 12 pushbutton station (15PBS1), complete with:

- Stack Storage Conveyor c/w loading station manual control (section # 13)
- Destacker c/w conveyor manual control (section # 15)
- One E-stop pushbutton for the whole Bale Handling System.

Note: The 15PBS1 pushbutton station will be installed on the side of the Destacker frame (Item # 15) directly fastened to the frame.

One Hydraulic Power Unit (60HPU1), complete with:

Note: See section # 4.7.9 for more details.

Other:

- One loop detector relay for clamp truck detection at Stack Storage Conveyor loading station.
- One loop detector relay for clamp truck detection at Stack Storage Conveyor unloading station.
- Wiring between ADCL supplied electrical components and locally mounted junction boxes, unless specified otherwise.

Note:
The loop detector relay is to be supplied in the equipment supplied junction box.

4.2.1.2 Control Specifications and Components:

Voltage and Pressure

Motor Voltage	480 Vac
Control Voltage	120 Vac inputs, 120 Vac outputs
Dry Air Supply	80 PSI
Hydraulic Pressure	1500 PSI

Electrical Components

Proximity Switches	Allen Bradley 872C Series
Limit Switches	Allen Bradley 802T Series
Photocells	Allen Bradley 9000 Series
Junction Boxes	Hoffmann NEMA 12
Terminal Blocks	Allen Bradley # 1492-W4 Series
Power Supplies	N/A

Pneumatic Components

Directional Solenoid Valves	MAC
Filters and Regulators	Master Pneumatics

Hydraulic Components

Pumps	Vickers
Directional Solenoid Valves	Vickers
Proportional Valves	Vickers
Cartridge Control Valves	Sun

4.2.1.3 Control Documentation

All the control drawings made by ADCL will be in the 11" x 17" format, drawn with AutoCAD version 2000. Microsoft "WORD" and "EXCEL" will also be used for reports, listings and other documents. The following is a list of the control documents to be supplied:

- Functional description;
- Logic flow diagrams of the automatic sequence;
- PLC program (on CD format only after start-up);
- Touch screen configuration & program (on CD format only after start-up);
- Instrument and panel location layout drawings;
- Panel arrangement drawings;
- Interconnection cable/wiring diagram drawings;
- Junction box drawings;
- 120 Vac distribution and emergency stop wiring diagrams;
- Input/output schematics;
- Motor list;
- Pushbutton station layouts and wiring diagrams;
- Pneumatic schematics;
- Hydraulic schematics.

4.2.2 Provided by Others

This section is used to establish control items supplied by others.

4.2.2.1 Controls Hardware/Software

The following are the major control components excluded from the ADCL scope of supply. These are to be supplied and installed by

Local Disconnect Switch (if required)

Motor Starters and VFD (if required)

Other:

- The loop detector relay is to be supplied by ADCL and located in the equipment supplied junction box. The loop itself is to be supplied and installed by as per instructions given on the appropriate mechanical drawing.
- All field wiring (cables, trays, conduits, etc) between and/or for: control panels, pushbutton stations, motor starters, VFD'S, junction boxes and safety instruments (where applicable).

4.2.2.2 Control Documentation

- Wiring interconnection details for all cables supplied and installed by between and/or for: control panels, pushbutton stations, motor starters, VFD'S, junction boxes and safety instruments (where applicable).

4.3 DESIGN SPECIFICATIONS

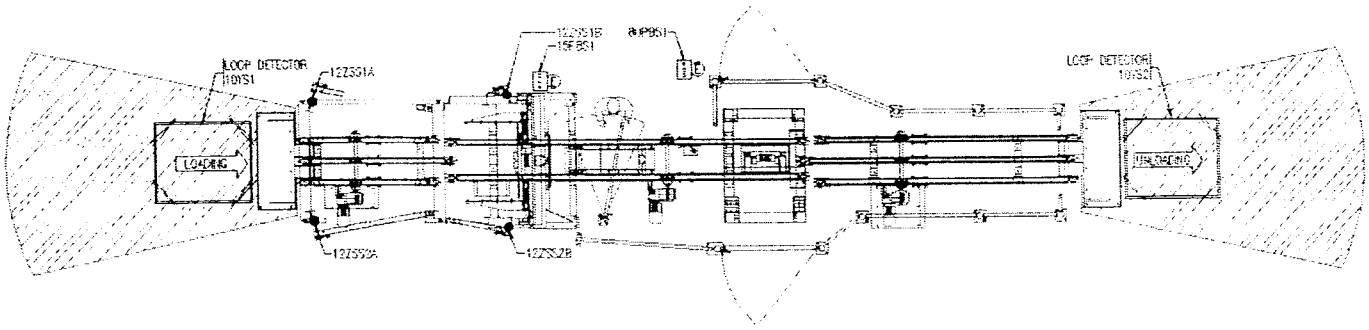
The system will be designed to handle bales of pulp. The system is designed for a capacity of 200 bales/shift (8hres). It is also designed for 24-hours/day operation, 7 days/week, 365 days/year.

4.3.1 Bale Specifications

Product Specs.		
	Minimum	Maximum
Length	32"	34"
Width	28"	30"
Height	16"	20"
Weight	500Lbs	550Lbs
Stack size (wired)		5 High
Stack size (dewired)		3 High

4.4 DEFINITION OF THE OPERATING AREAS

The bale handling system is divided in the different sections described at section 4.4.1. These sections will be regrouped in different areas in order to describe the operation of the different sections.



4.4.1 The system sections

The sections consists of:

- Section # 10: Truck guard c/w Loop Detector (infeed and outfeed)
- Section # 11: Infeed Stack Storage Conveyor
- Section # 12: Safety Fence
- Section # 13: Manual Dewiring Conveyor
- Section # 15: Destacker
- Section # 16: Stacker
- Section # 19: Outfeed Stack Storage Conveyor

The operation of these sections will be described in section 4.5.1 of this document.

4.5 SYSTEM OVERVIEW

The Bale Handling System is designed to handle and deliver bales within the limitations described above in point 4.3. Its function and operation will be divided according to the two operating zones described earlier.

The following sections describe the normal automatic operation mode.

4.5.1 The Sections Operation

NOTE: The system will not run in the automatic mode if the Hydraulic Power Unit is not running.

4.5.1.1 Loading Area (sections #10, 11 & 12)

In this area the clamp truck will load the bale stacks, five high, onto the Stack storage conveyor.

When the clamp truck is detected in front of the Loading Station the following sequence is initiated:

- The sequence starts when the loading area is empty and stack storage conveyor is stopped.
- The lift truck must place the stack squarely and centred onto the Stack Storage Conveyor.
- Once the stack is stable, the truck can now reverse and leave the loading area. The absence of the truck on the loop detector initiates the next function.

The Stack Storage Conveyor (section #11) is surrounded by safety fences (section #12), which should contain any stack toppling onto the conveyor. The side sections of these fences can be manually opened for cleaning and/or to remove fallen bales.

The Stack Storage Conveyor (section #11) accumulates stacks of bales or delivers one stack to the Manual Dewiring Conveyor (section #13) upon it's request:

- When a new stack is deposited on the Stack Storage Conveyor at the Loading Station it moves forward (towards the Destacker) until a stack is in position before the Manual Dewiring Conveyor. It holds this position until a new stack is received or until the Destacker Conveyor requests a stack.
- When the Destacker is empty the Stack Storage Conveyor advances the stacks (towards the Destacker) until a stack transfers over to the Destacker Conveyor (section # 13). The Stack storage conveyor is then ready to accumulate or

deliver another stack. A run out timer will stop the conveyor, in both directions, if no stacks are on the conveyor.

4.5.1.2 Destacker Area (section #15)

A bale stack is transferred from the Stack Storage Conveyor (section #11) to the Manual Dewiring Conveyor (section #13). This transfer is only allowed when the Destacker (section #15) is empty, the Destacker clamps are opened and in the down position and the destination matches the previous stack's destination if the batch is incomplete.

The stack travels forward until it reaches the stack clamping position, which is detected by a mechanical spring loaded plate. This detection mechanism is not affected by paper flaps or other contaminants. When the stack is in place, the Destacker clamps close on the bales and raise the stack off the conveyor.

When in position, the clamp assembly will shift sideways to aligned the edge of the bottom bale of the lifted stack to the system pass-line. The Destacker clamps will lower to deposit the stack bales onto the conveyor. The clamps will then open and raise to the second bale level where they will clamp the bale and lift the remaining bales.

When no bale is detected at the second bale clamp position, the clamps stay open. The last bale is then transferred on the Manual Dewiring Conveyor. The Destacker clamps lower to the down position, ready for the next stack.

4.5.1.3 Manual Dewiring Area (section #13 & 14)

Wired bales are received at the Manual Dewiring (section #13) from the Destacker (section # 15). When the bale is located at the dewiring table position, the table will raise and a pilot light will flash on the push button station 80PBS1 which indicates to the operator that the bale is ready to be dewired.

The operator will cut and remove the wires from the bale. When the wires are removed, the operator presses the appropriate buttons on # 80PBS1 pushbutton station The operator re-initiates the sequence that sends the dewired bale to the Stacker (section #16) and brings another bale to the Manual Dewiring Conveyor (section #13). Once the operator initiates the sequence, the manual dewiring table will lower, the Manual Dewiring Conveyor will run forward (towards the Stacker), bringing a new bale to the manual dewiring table and at the same time sends the dewired bale to the stacker.

4.5.1.4 Stacker Area (section #16)

Dewired bales are received from the Manual Dewiring Conveyor (section #13). The bales will advance towards the stacker (section #16). When the bales is at the Stacker position, the stacking sequence is as follows:

- The stacker bale lifter will raise until the bale is at the height of the side paddles and the switches that detect the tilting of the paddles are activated.
- The paddles will open to allow the passage of the bale.
- The stacker bale lifter will raise to its fully up position.
- The paddles will close
- The stacker bale lifter will lower to is fully down position

When the last bale of the stack is at the Stacker, the Stacker bale lifter will raise to the paddle height. The paddles open and the bale lifter will lower in order to deposit the stack onto the conveyor. The stack of 3 dewired bales is now ready to be sent to the Outfeed Stack Storage conveyor.

4.5.1.5 Outfeed Stack Storage Area (section #19)

In this area the clamp truck will offload the dewired bales stacks, three high, from the Outfeed Stack Storage Conveyor.

When the clamp truck is detected at the end of the Outfeed Stack Storage Conveyor, the following sequence is initiated:

- No bale stacks are transferred from the Stacker, the Outfeed Stack Storage Conveyor
- The conveyor will stop and the stack will be ready to be picked up by the lift truck.
- Once the lift truck has cleared the unloading area, the Outfeed Stack Storage Conveyor will forward, in order to approach the stacks being transferred from the stacker area.

4.6 SAFETY & EMERGENCY STOP PROCEDURES

Applicable to the Bale Handling System:

Two emergency stop devices are part of this system. These are distributed as follow:

1. One E-stop mushroom type pushbuttons on 15PBS1 located on the Destacker.
2. One E-stop mushroom type pushbuttons on 80PBS1 located at the Manual Dewiring Station.

These emergency stops are to be activated in case of an **emergency only.**

Four safety door switches installed are part of this system. Those are distributed as follow:

1. One safety door switch for both doors of the Destacker area safety fence.
2. One safety door switch for each of the three Dewiring area handrail entrances.

Activation of any of these will drop the zone MCR relay and alarm the operator, via the 80HMI1 Human Machine Interface, that an emergency stop or a safety switch has been activated.

All of the zone's motor starters and/or VFD control power will be hardwired through a normally open contact of the zone MCR relay. Thus, dropping of the MCR relay will disable all motors.

Any motion controlling PLC output module for a zone will have the power cut in case of an emergency stop. To achieve this, the power to each individual PLC output module will be fed through a normally open contact of the appropriate MCR relay. Therefore, dropping the MCR relay will cut power to all hydraulic and pneumatic solenoid valves in the system. Note however that 4-20mA inputs/outputs and the 120Vac inputs signals in this system will not be de-energised upon an emergency stop.

To re-arm the MCR relay, all emergency stop pushbuttons must be not pressed and the safety gates must be closed. The reset pushbutton will have to be pressed. The reset button is located on the 80PBS1 pushbutton station.

4.7 MECHANICAL EQUIPMENT SECTIONS AND RELATED CONTROLS

The system supplied will be divided into various mechanical sections, each having their own related control elements and/or features. The following section lists these according to the ADCL mechanical section number and as they appear on the mechanical general layout drawing listed above in section 4.3.

4.7.1 Truck Guard c/w Loop Detector (2) (section #10)

Mechanical assembly drawing # MI00-C4-33467

The truck guard is a mechanical structure with no associated controls. Its sole purpose is to protect the Loading Station and the Stack Storage Conveyor (section # 11)

The loop detector referred to in the mechanical section title is to indicate that ADCL is supplying a "Single Channel Inductive Loop Vehicle Detector". This relay type device will be located inside the local Junction Box 10JBC1 & 10JBC2.

... .nstall the detecting loop embedded in the concrete floor in front of the Truck Guard.

http://www.renoae.com/Documentation/MISC/Loop Installation 03-27-02.pdf

4.7.1.1 Hardware Description:

No.	Component	Description	Characteristics
1	N/A		

4.7.1.2 Manual Controls for Operator and/or Maintenance Intervention:

N/A

4.7.2 Stack Storage Conveyor (section # 11)

Mechanical assembly drawing # DA06-D3-33468

4.7.2.1 Hardware Description:

No.	Component	Description	Control Interface
1	Motor (1)	Stack Storage Conveyor motor (11M1).	Reversible Motor starter with 1 input 120Vac, and 2 isolated outputs 120Vac
2	Photocell (3)	Bale present at infeed (11YS1) Bale present at outfeed (bottom) (11YS2) Bale present at outfeed (top (11YS3)	120Vac, digital input (3)

4.7.2.2 Manual Controls for Operator and/or Maintenance Intervention:

A spring centred three-position selector switch is located on pushbutton station 15PBS1, located on the Side of the Destacker (section # 15), to run forward or reverse the Stack Storage Conveyor.

4.7.3 Safety Fences (section # 12)

Mechanical assembly drawing # GM00-D3-33469

The safety fence frames are of all welded, steel pipe sections, cross-braced and tied together at top to secure the stack storage conveyor. The fencing is equipped with appropriate swing out access panels.

4.7.3.1 Hardware Description:

No.	Component	Description	Characteristics
1	Proximity Switch (4)	Safety Gates Closed (12ZSS1A, 12ZSS1B, 12ZSS2A, 12ZSS2B)	120Vac, digital inputs (4)

4.7.3.2 Manual Controls for Operator and/or Maintenance Intervention:

N/A

4.7.4 Manual Dewiring Conveyor (section # 13)

Mechanical assembly drawing # DA06-D3-33470

4.7.4.1 Hardware Description:

No.	Component	Description	Characteristics
1	Motor (1)	Stack Storage Conveyor motor (13M1).	Reversible Motor starter with 1 input 120Vac, and 2 isolated outputs 120Vac
2	Proximity Switch (3)	Manual Dewiring Lifting Table raised position (13ZSH1) Manual Dewiring Lifting Table lowered position (13ZSL1) Bale at Stacker entrance (13ZS1)	120Vac, digital input (3)
3	Pneumatic Air Bag (1)	Pivoting end of Manual Dewiring Lifting Table raise and lower (13EV1A/B)	Double solenoid 120Vac, digital outputs (2)

4.7.4.2 Manual Controls for Operator and/or Maintenance Intervention:

Spring centred three-position selector switches located on pushbutton station 80PBS1, located at the operator station, for jogging the stack storage conveyor in the forward or reverse direction and raising or lowering the pivoting end of the Manual Dewiring Lifting Table.

4.7.5 Manual Wire Cutter (section # 14)

Mechanical assembly drawing # MV00-D3-33471

Desouter 4DU tool balancer mounted on hollow structural steel frame including a pneumatically activated Niles wire cutter.

4.7.5.1 Hardware Description:

No.	Component	Description	Characteristics
	N/A		

4.7.5.2 Manual Controls for Operator and/or Maintenance Intervention:

N/A

4.7.6 Destacker (section # 15)

Mechanical assembly drawing # GB00-D3-33472

4.7.6.1 Hardware Description:

No.	Component	Description	Characteristics
1	Photocell (1)	Detects the second bale in the Destacker clamp (15YS2).	120Vac, digital input (1)
2	Proximity Switch (8)	Destacker clamp at pass line side (15ZS1) Destacker stack plate stop detecting stack (15ZS2) Destacker clamp in clamping position (15ZSH1) Destacker clamp up position (15ZSH2) Destacker clamp down position (15ZSL1) Destacker clamp down pulsing (15ZSL2) Destacker pass line side clamp opened (15ZSO1) Destacker opposite to pass line side clamp opened (15ZSO2)	120Vac, digital input (8)
3	Hydraulic cylinder (3)	Destacker clamp shift pass line side (15EV1A) Destacker clamp opposite to pass line side shift (15EV1B) Destacker clamp lower (15EV2A) Destacker clamp raise (15EV2B) Destacker clamp lock A shifting (15EV3) Destacker clamp lock B shifting (15EV4) Destacker clamp open (15EV5A) Destacker clamp close (15EV5B)	3 Double solenoid Spring centred type 120 Vac, Digital outputs (6) 2 Single solenoid 120Vac, digital outputs (2)

4.7.6.2 Manual Controls for Operator and/or Maintenance Intervention:

If in manual mode, the Destacker can be operated using three-position selector switches located on pushbutton station 15PBS1, located on the side of the Destacker (section # 15).

4.7.7 Stacker (section # 16)

Mechanical assembly drawing # DS00-D3-33473

4.7.7.1 Hardware Description:

No.	Component	Description	Characteristics
1	Proximity Switch (8)	Stacker pass line side paddle tilt detector (16ZS1) Stacker opposite to pass line side paddle tilt detector (16ZS2) Stacker pass line side paddle open detector (16ZSO1) Stacker opposite to pass line side paddle open detector (16ZSO2) Stacker pass line side paddle close detector (16ZSC1) Stacker opposite to pass line side paddle close detector (16ZSC2) Stacker bale lifter raised detector (16ZSH1) Stacker bale lifter lowered detector (16ZSL1)	120Vac, digital input (8)
2	Photocell (1)	Stacker bale raised over limit (16YS1)	120Vac, digital input (1)
3	Hydraulic cylinders (3)	Stacker pass line side paddle open detector (16EV1) Stacker opposite to pass line side paddle open detector (16EV2) Stacker bale lifter raise (16EV3A) Stacker bale lifter lower (16EV3B)	Single and Double solenoid Type digital outputs (4)

4.7.7.2 Manual Controls for Operator and/or Maintenance Intervention:

If in manual mode, the Stacker can be operated using three-position selector switches located on pushbutton station 80PBS1.

4.7.8 Outfeed Stack Storage Conveyor (section # 19)

Mechanical assembly drawing # DA06-D3-33475

4.7.8.1 Hardware Description:

No.	Component	Description	Characteristics
1	Photocell (1)	Bale presence at outfeed (19YS1)	120Vac, digital inputs (1)
2	Motor (1)	Outfeed Stack Storage Conveyor motor (19M1)	Reversible motor starter with 1 input 120Vac and 2 outputs isolated 120Vac

4.7.8.2 Manual Controls for Operator and/or Maintenance Intervention:

A spring centred three-position selector switch is located on pushbutton station 80PBS1 to jog the Outfeed Stack Storage Conveyor forward or reverse.

4.7.9 Hydraulic Power Unit (section # 60)

Hydraulic assembly drawing # ZB00-B7-33406

4.7.9.1 Hardware Description

No.	Component	Description	Characteristics
1	Motor (3)	Hydraulic Power Unit Main Pump motor (60M1) Hydraulic Power Unit Recirculation Pump motor (60M2) Hydraulic Power Unit Cooling Fan motor (60M3)	Non reversing motor starter with 1 input 120Vac and 1 output isolated 120Vac for each motor. 120Vac, digital inputs (3) 120Vac, digital output (3)
2	Monitoring switches (5)	60LSLL1: oil level ok to run. 60TSH1: cooling temperature reached, start cooling fan 60TSHH1: temperature ok to run 60PDSH1: Filter not clogged recirculation. 60PSH1: Main Pressure Ok	120Vac, digital inputs (5)

4.7.9.2 Manual Controls for Operator and/or Maintenance Intervention:

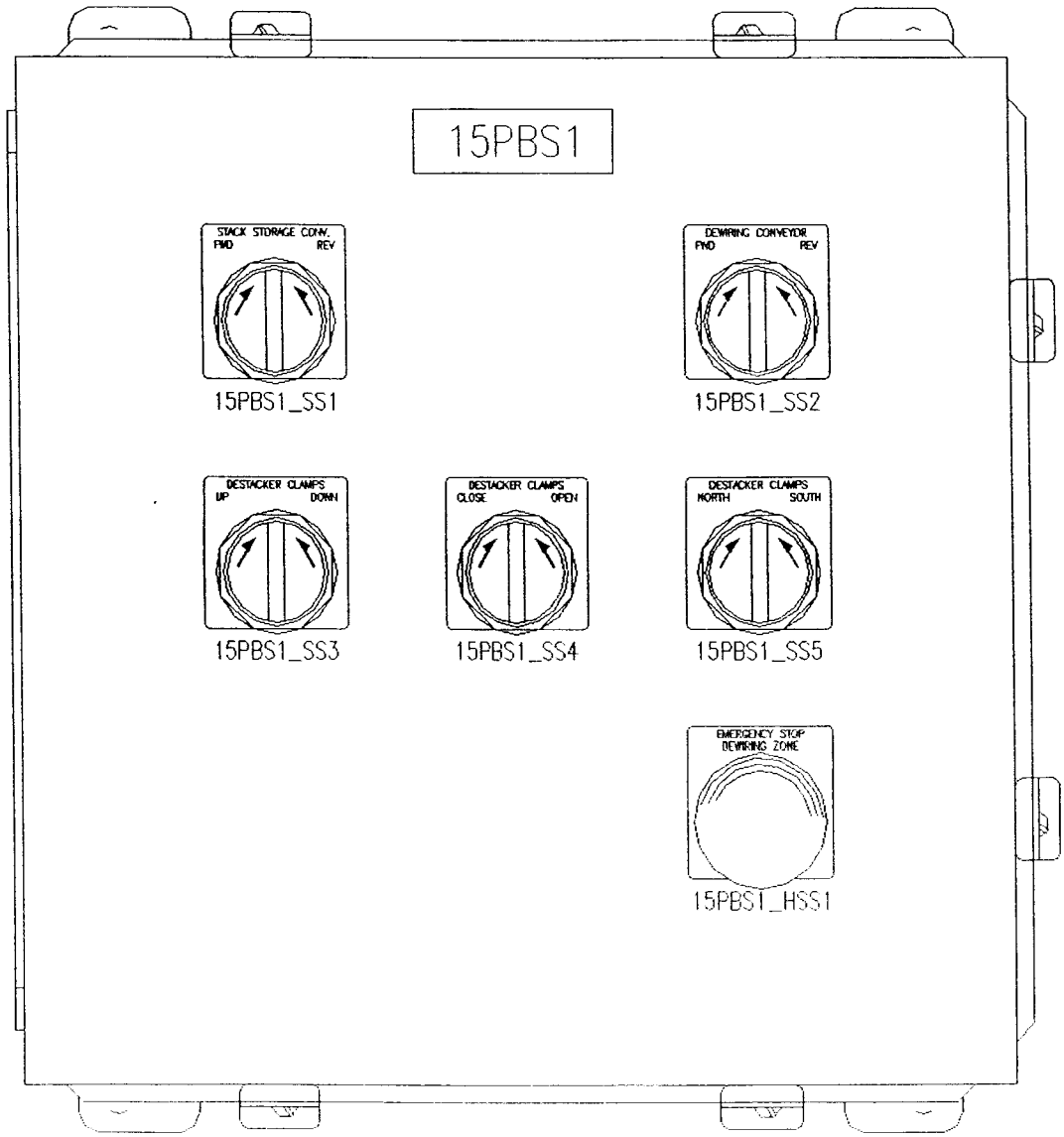
The power unit can be monitored, started and stopped from the Touch screen.
See section # 4.9.2

4.8 Pushbutton station

The following push button stations are to control and verify the Bale Handling System.

4.8.1 Destacker Pushbutton Station 15PBS1

The pushbutton station 15PBS1 is for the manual control of the Destacker and the Infeed Stack Storage Conveyor.



4.8.2 Main Pushbutton Station 80PBS1

The pushbutton station 80PBS1 is for the manual control of the Manual Dewiring Conveyor, the Stacker and the outfeed Stack Storage Conveyor. It also includes the principal commands to the Bale Handling System (Auto/Manual, E-stop reset, Dewirig Confirmation).