



Digital Series Manipulators



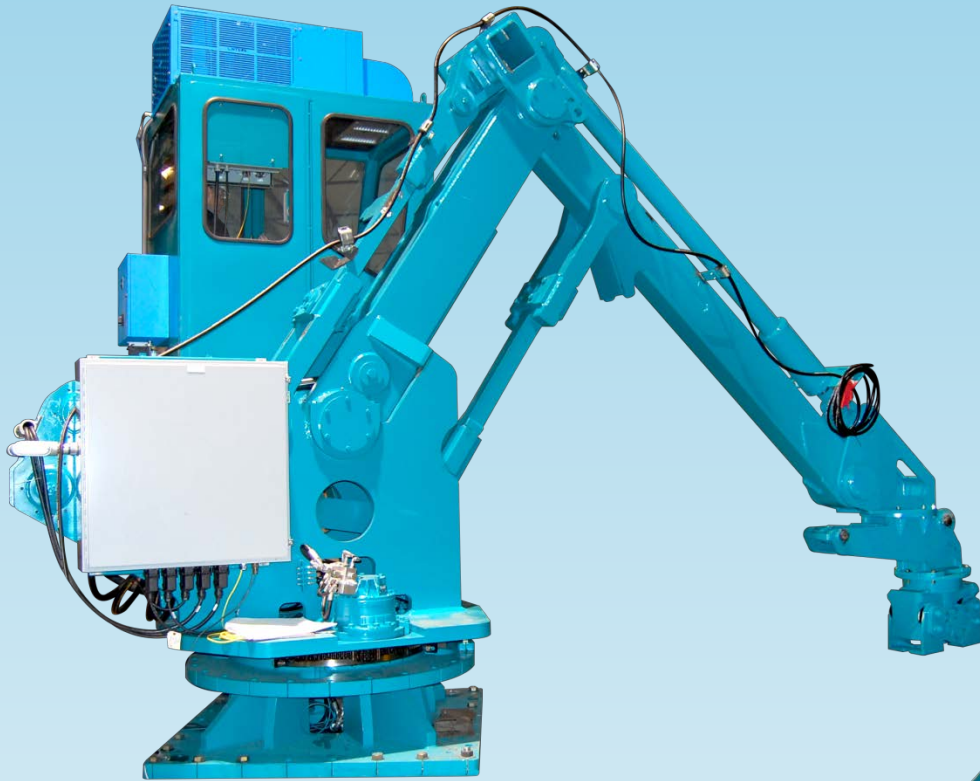
Basic Design Criteria

...Standard on *Digital Series!*

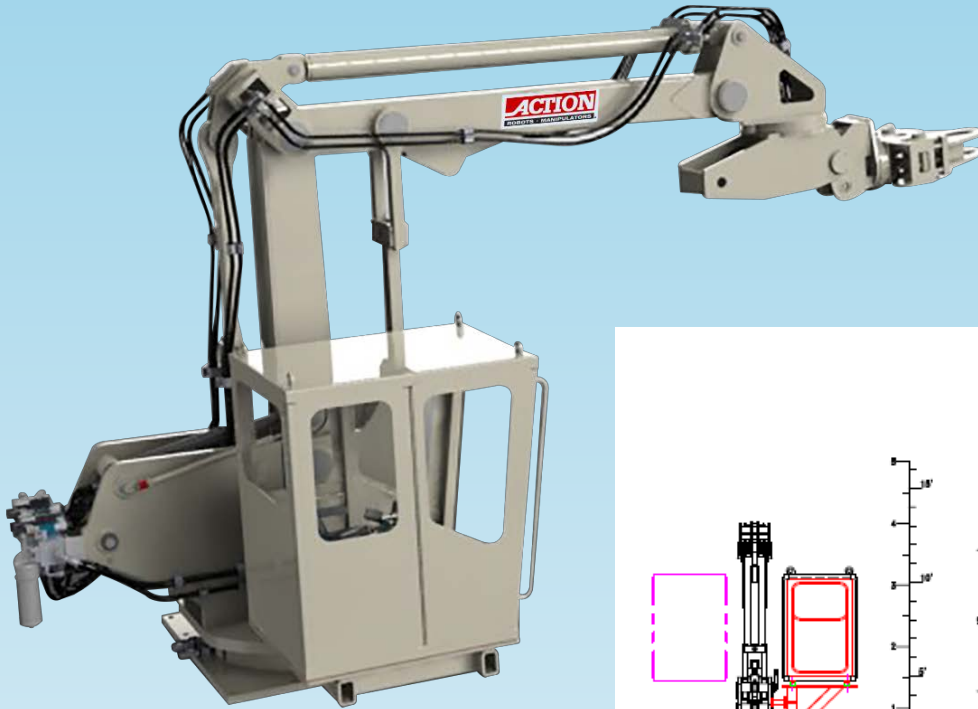
- ✓ Several Standard Models with 500–3000 kg payload capacity. Sweep envelopes to meet individual requirements
- ✓ Grapple attachment for handling a wide variety of items
- ✓ Cab, left, right side mounting
- ✓ Engineered robust hydraulic/pneumatic hose and tube routing throughout machine
- ✓ Service plug connections in cab
- ✓ **REAL** diagnostics – not just cryptic codes
- ✓ Open architecture controls, industry–standard components, **NO** proprietary hardware



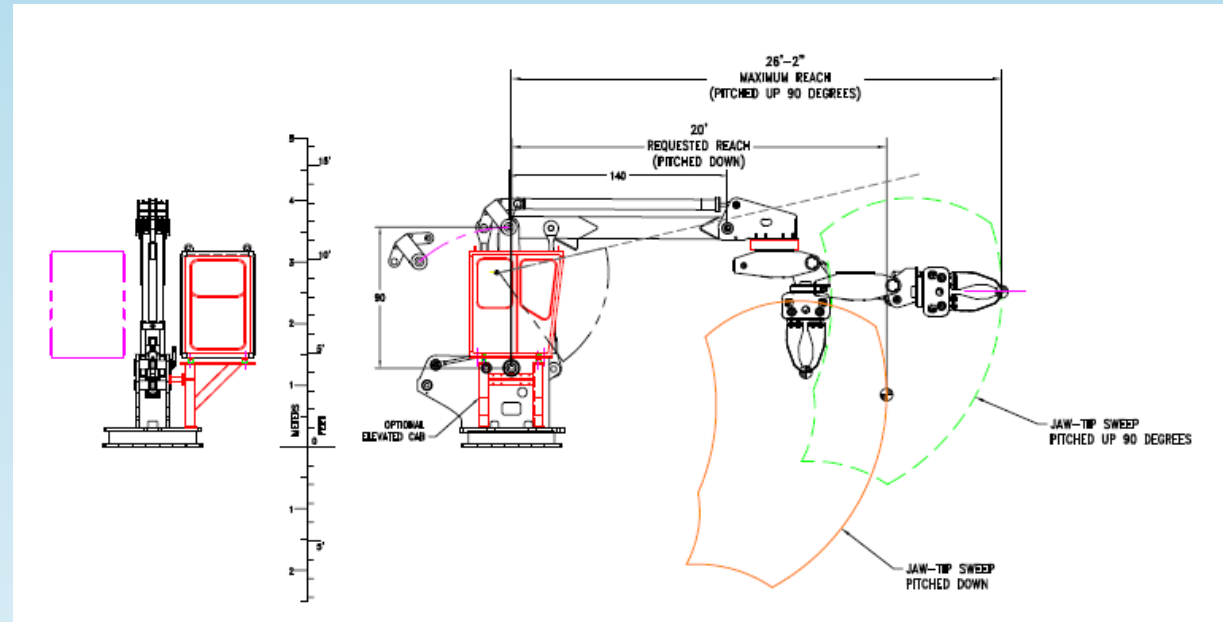
Machine Structure



Lift Capacity & Reach

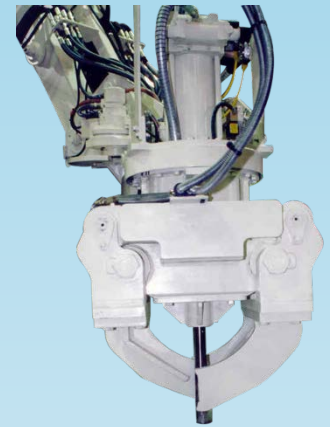
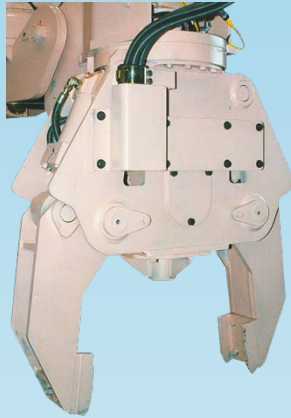


- ✓ *Rated capacity through entire range of motion, including Pitch and grapple rotate*



Attachments for Any Job

Patented Grapple/Impactor™



Breaker Grapple

Hot Casting Grapple

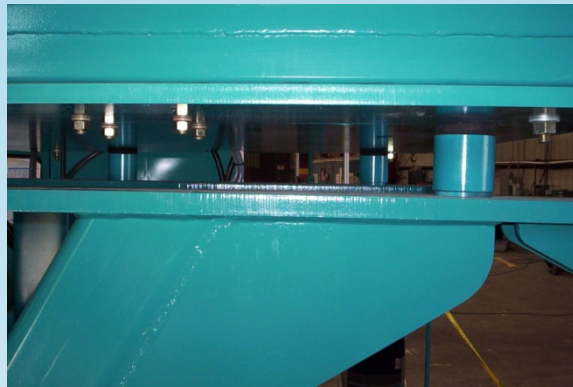


Optional Elevated Cab –Versatile Mount



RH Mounted

Heavy Duty Mounting

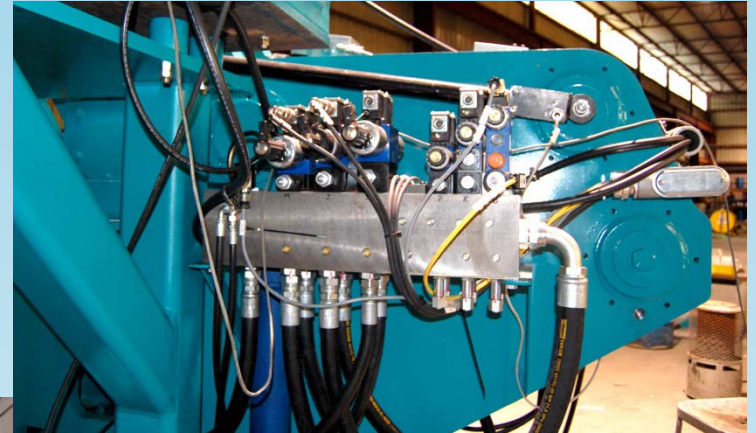


...with Isolators

LH Mounted

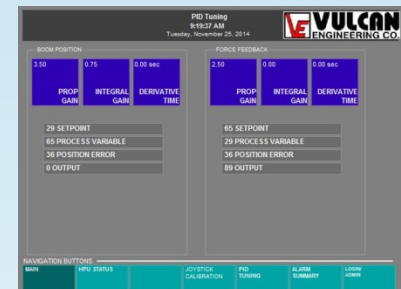
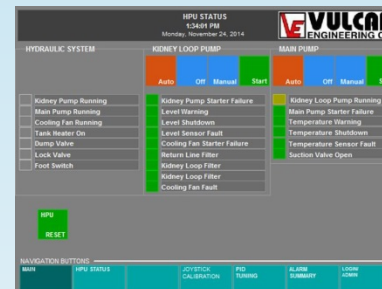
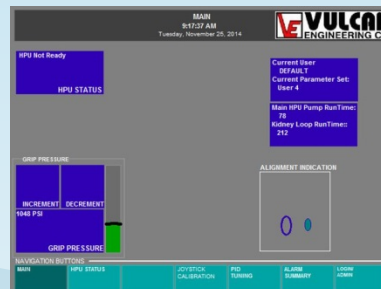


Engineered Hose Routing



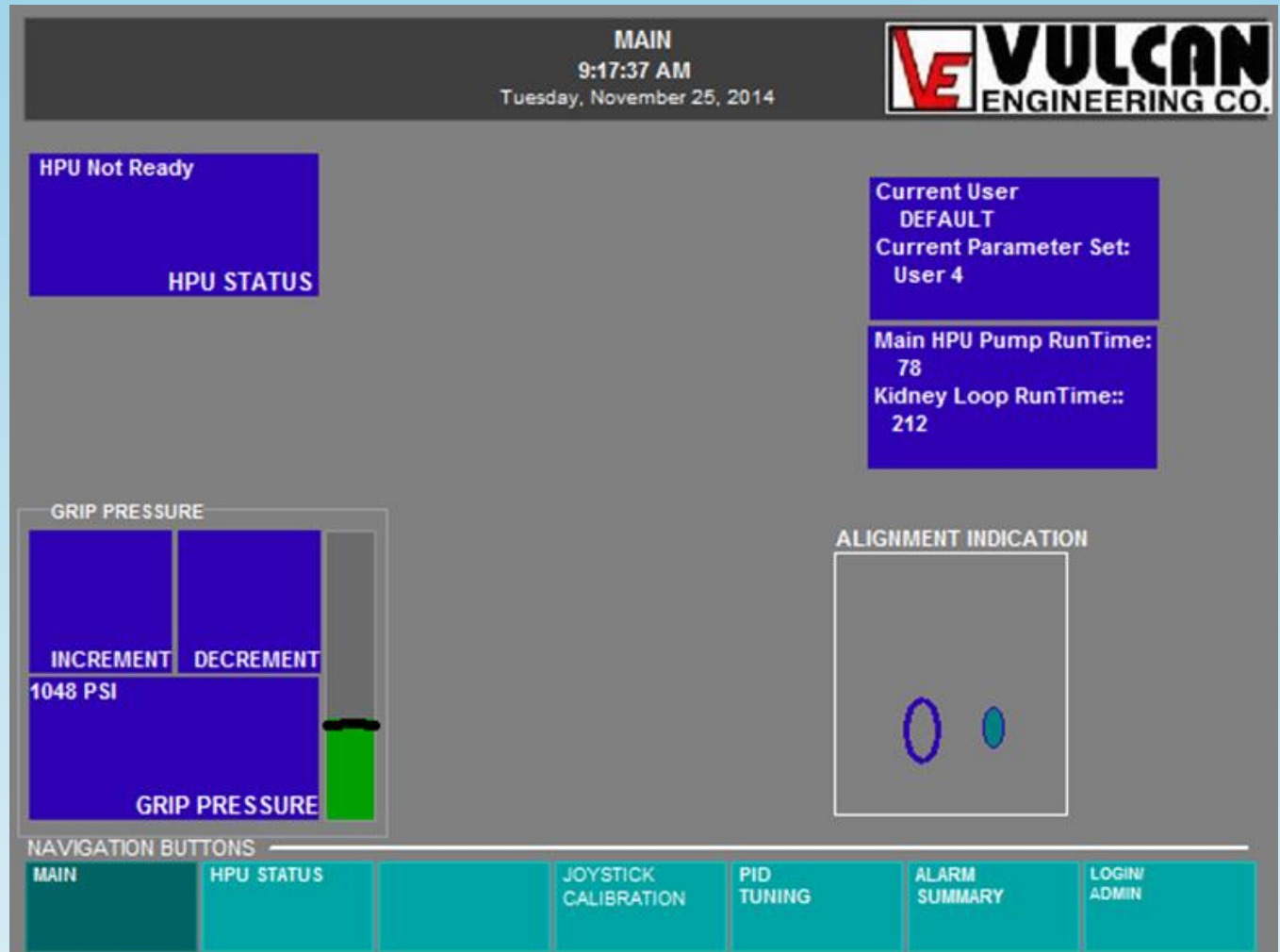
Connectivity & Control

- ✓ PLC with Ethernet communication, network I/O and touch-screen
- ✓ Ethernet port for connection of customer PC
- ✓ Service receptacle for customer use
- ✓ Simple control/monitoring of peripheral equipment; discrete switches and buttons available for heavily-used functions.
- ✓ Diagnostics in plain language on HMI
- ✓ In-cab tuning via HMI



In-Cab Connectivity & Control

The Main screen allows the operator to easily align the hand control and boom position before unlocking the lock valves.



In-Cab Connectivity & Control

Joystick calibration allows for quick set up of the joystick parameters.

Indicator lights to assist in troubleshooting.

The screenshot displays the 'Joystick Calibration' screen. At the top, it shows the time '9:19:19 AM' and the date 'Tuesday, November 25, 2014'. The 'VULCAN ENGINEERING CO.' logo is in the top right corner. The main area features a joystick diagram with several indicator lights: a blue oval at the center, a vertical blue bar on the right, and a purple oval at the bottom. Below the diagram are three rows of blue buttons for parameter adjustment: 'CCW Twist Value', 'Middle Twist Value', 'CW Twist Value'; 'Pull Value', 'Middle Value', 'Push Value'; and 'Left Value', 'Middle Value', 'Right Value'. At the bottom, a 'NAVIGATION BUTTONS' bar contains seven buttons: 'MAIN', 'HPU STATUS', 'JOYSTICK CALIBRATION', 'PID TUNING', 'ALARM SUMMARY', and 'LOGIN ADMIN'.



In-Cab Connectivity & Control

The HPU is Controlled from the HMI Screen

HMI Screen shows the Status of HPU component conditions.

The HMI screen displays the following information:

- HPU STATUS**
1:34:01 PM
Monday, November 24, 2014
- VULCAN ENGINEERING CO.** logo
- HYDRAULIC SYSTEM**
 - Kidney Pump Running
 - Main Pump Running
 - Cooling Fan Running
 - Tank Heater On
 - Dump Valve
 - Lock Valve
 - Foot Switch
- KIDNEY LOOP PUMP**
 - Auto (orange)
 - Off (blue)
 - Manual (blue)
 - Start (green)
 - Kidney Pump Starter Failure
 - Level Warning
 - Level Shutdown
 - Level Sensor Fault
 - Cooling Fan Starter Failure
 - Return Line Filter
 - Kidney Loop Filter
 - Kidney Loop Filter
 - Cooling Fan Fault
- MAIN PUMP**
 - Auto (orange)
 - Off (blue)
 - Manual (blue)
 - Start (green)
 - Kidney Loop Pump Running
 - Main Pump Starter Failure
 - Temperature Warning
 - Temperature Shutdown
 - Temperature Sensor Fault
 - Suction Valve Open
- HPU RESET** (green button)
- NAVIGATION BUTTONS**
 - MAIN
 - HPU STATUS
 - JOYSTICK CALIBRATION
 - PID TUNING
 - ALARM SUMMARY
 - LOGIN/ADMIN



In-Cab Connectivity & Control

Alarm Summary provides a history of warnings and problems that have occurred.

This Simplifies maintenance & troubleshooting.

ALARM SUMMARY
9:20:25 AM
Tuesday, November 25, 2014

VE VULCAN ENGINEERING CO.

Message

- 11/25/2014 9:16:00 AM Extend Boom Position Deviation Alarm
- 11/25/2014 9:16:00 AM Extend Force Feedback Deviation Alarm
- 11/25/2014 9:15:57 AM Lift Force Feedback Deviation Alarm
- 11/25/2014 9:16:28 AM Emergency Stop

Alarm History Navigation

Reset System Alarms

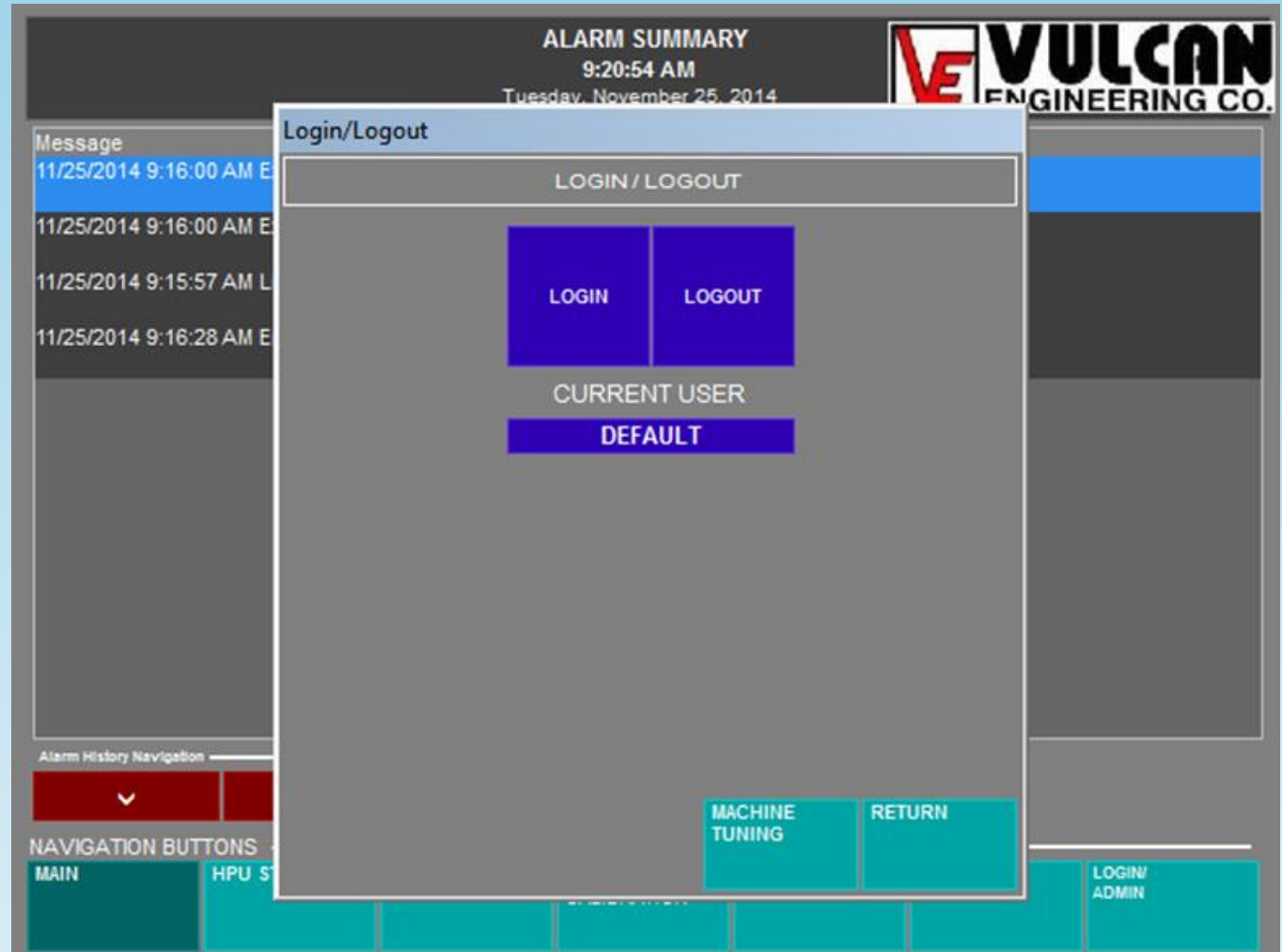
NAVIGATION BUTTONS

MAIN	HPU STATUS		JOYSTICK CALIBRATION	PID TUNING	ALARM SUMMARY	LOGIN/ ADMIN
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In-Cab Connectivity & Control

Login window provides User level security. There are different levels of access for operators, supervisors, and maintenance.



In-Cab Connectivity & Control

Tuning of the main axis of movement is easily performed from the HMI Screen.

The screenshot displays the 'PID Tuning' interface for a boom position system. At the top, it shows the title 'PID Tuning', the time '9:19:37 AM', and the date 'Tuesday, November 25, 2014'. The 'VULCAN ENGINEERING CO.' logo is in the top right corner. The interface is divided into two main sections: 'BOOM POSITION' and 'FORCE FEEDBACK'. Each section has three blue buttons for 'PROP GAIN', 'INTEGRAL GAIN', and 'DERIVATIVE TIME'. Below these are four grey buttons for 'SETPOINT', 'PROCESS VARIABLE', 'POSITION ERROR', and 'OUTPUT'. At the bottom, a 'NAVIGATION BUTTONS' bar contains seven buttons: 'MAIN', 'HPU STATUS', 'JOYSTICK CALIBRATION', 'PID TUNING', 'ALARM SUMMARY', and 'LOGIN/ADMIN'.

Section	Parameter	Value
BOOM POSITION	PROP GAIN	3.50
	INTEGRAL GAIN	0.75
	DERIVATIVE TIME	0.00 sec
BOOM POSITION	29 SETPOINT	
	65 PROCESS VARIABLE	
	36 POSITION ERROR	
	0 OUTPUT	
FORCE FEEDBACK	PROP GAIN	2.50
	INTEGRAL GAIN	0.00
	DERIVATIVE TIME	0.00 sec
FORCE FEEDBACK	65 SETPOINT	
	29 PROCESS VARIABLE	
	36 POSITION ERROR	
	89 OUTPUT	



Industry Standard Components

- ✓ PLC & Touchscreen, Ethernet
- ✓ Standard network I/O for efficient cabling
- ✓ Newest generation control-integrated valves commanded directly from PLC – absolutely NO proprietary cards or circuitry
- ✓ Open standards for programming
- ✓ Top-quality HPU featuring readily available hydraulic components



Ease of Use

- ✓ Hand control is primary user interface
- ✓ Hand control is instantly intuitive as hand motion directly corresponds to boom motion
- ✓ Intuitive, user-friendly HMI provides *real* information during normal operation and error/alarm events

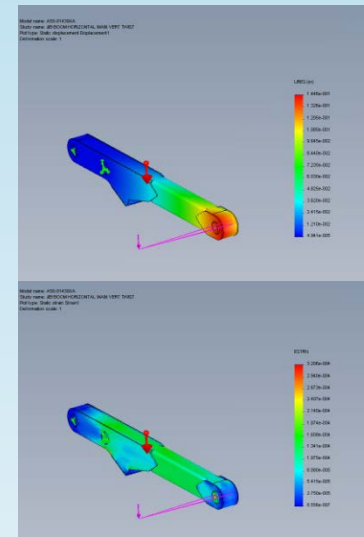
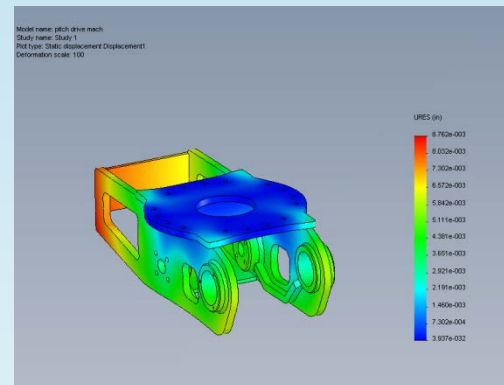
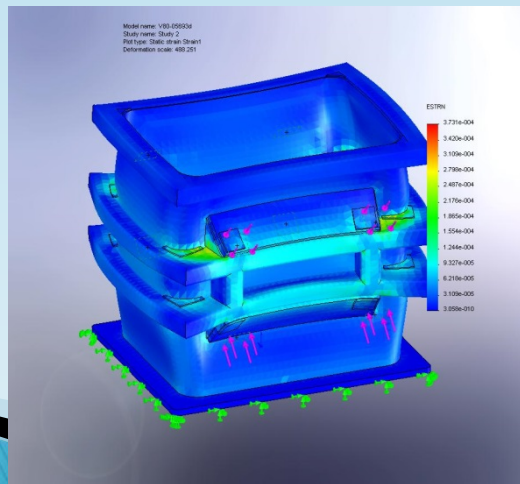
Ease of Maintenance

- ✓ Common, industry standard parts
- ✓ Designed in 3D and checked for accessibility and ease of assembly
- ✓ Plain Language error/troubleshooting info via the HMI – no error codes to look up or voltages to manually check
- ✓ In-cab tuning of the motion controls, so a single technician can perform the job quickly
- ✓ Easily expandable to accommodate future requirements



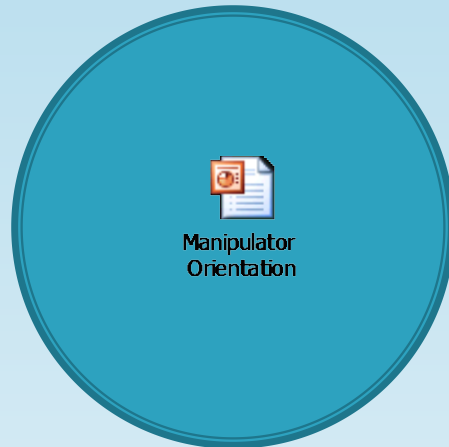
Design Engineering

- ✓ Design & detail engineering done in-house by a cross-trained staff of engineers involved daily with robotics & manipulators)
- ✓ 3D and 2D CAD programs used for machine design
- ✓ FEA is employed in critical areas to maximize reliability and product life.



Training

- ✓ (3) Levels of Training
 - ✓ Production
 - ✓ Maintenance
 - ✓ Engineering
- ✓ Classroom and hands-on training at the machine



History/Experience with ACTION®

- ✓ In the market: Over 500 ACTION® Manipulators and Robots sold since the mid 1970's
- ✓ Majority of machines in marketplace are based on 1980's technology, with incremental improvements in the 1990's and 2000's
- ✓ Control technology primarily from the 1990's



...Enter *Digital Series ACTION*[®] Manipulators

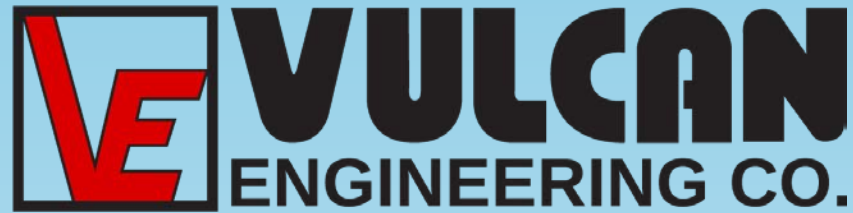
- ✓ Based upon years of discussion with manipulator users *and* our experience in other areas
- ✓ Latest hydraulic control elements, mechanical design
- ✓ Digital control system, exploiting latest practical capabilities while maintaining simplicity
- ✓ Industry-standard hardware with open-source components and programming, non-proprietary!
- ✓ Depth and breadth of experience in different plants with different machinery, crucial for effective new designs—a major advantage over one-dimensional companies.



In Summary...

- ✓ *Digital Series ACTION*® Manipulator is a truly up-to-date design—the most current available
 - ✓ Latest technology in mechanical and hydraulic components
 - ✓ Industry-standard digital controls—open, customizable, expandable, with no proprietary components
- ✓ Vulcan Engineering Co. has the depth and breadth of experience and personnel to collaborate with Customer on configuring, deploying and supporting equipment.





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