Preliminary/ for Information	for Comment / Approval	Final Issue		
			JACKING SYSTEM OPERATION AND MAINTENANCE MANUAL FOR GMS ENTERPRISE GustoMSC ref P 11807-10802 rev 0	
			Client	Gulf Marine Services W.L.L.
			Client doc nr	
PI	CA	FI	Unit	NG-2500X

STATUS			ISSUE		DATE	PREPARED BY		REVIEWED BY		APPROVED BY	
X			First	0	July 31, 2014	BSS		VEP		FRU	
			Revision	A							
			Revision	B							
			Revision	C							
			Revision	D							
			Revision	E							
			Revision	F							

Copyright of GustoMSC whose property this document remains. No parts thereof may be disclosed, copied, duplicated or in any other way made use of except with the written approval of GustoMSC.

GustoMSC

Karel Doormanweg 25, P O Box 687
3100 AR Schiedam, the Netherlands
Telephone: +31 - (0)10 - 2883 000
Fax: +31 - (0)10 - 2883 001
E-mail: GustoMSC@GustoMSC.com
Website: www.GustoMSC.com

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. ABBREVIATIONS 1
1.2. CONTACT DETAILS / SERVICE REQUESTS 2
1.3. REVISIONS 2

2. SAFETY PRECAUTIONS 3
2.1. GENERAL SAFETY ASPECTS 4
2.2. SPECIFIC SAFETY ASPECTS 7

3. DESIGN CONDITIONS 8
3.1. JACKING CAPACITIES 8
3.2. DESIGN LIFE 8
3.3. OPERATIONAL LIMITS 9
3.4. VELOCITIES 10
3.5. ENVIRONMENTAL CONDITIONS 11

4. SYSTEM DESCRIPTION 12
4.1. GENERAL 12
4.2. DESCRIPTION OF THE MECHANICAL SYSTEM 13
4.3. DESCRIPTION OF THE E&I / CONTROL SYSTEM 16

5. HMI ENVIRONMENT 22
5.1. COLOR DEFINITION 22
5.2. SCREEN LAYOUT 23
5.3. WORKSPACE 26
5.4. BUTTON AREA 37
5.5. WINCC OPERATOR INTERVENTIONS 40
5.6. FACEPLATES 42
5.7. LOGIN AND AUTHORIZATION 44
5.8. ENABLE OVERRIDE OVER INCOMING ALARM 45
5.9. ACKNOWLEDGE ALARMS AND MESSAGES 46
5.10. MESSAGE PAGES (ALARMS, SYSTEM MESSAGES, WARNINGS) 47
5.11. EVENT CLASSES 49

6. FUNCTIONAL DESCRIPTION CONTROL SYSTEM 50
6.1. LAYOUT CENTRAL CONTROL DESK (CCD) 50
6.2. LAYOUT LOCAL CONTROL PANELS (LCP) 52
6.3. OFF / STANDBY / ON 54
6.4. LOCAL / REMOTE 55

6.5. JOYSTICKS 57
6.6. OPERATING MODE 57
6.7. AUTO LEVEL 58
6.8. CHANGING SPEED SETPOINT 60
6.9. BRAKE FUNCTIONALITY 61
6.10. STOPPING MODES 62
6.11. ALARM HANDLING AND RESET PROCEDURE 63
6.12. LEG EXTENSION AND LEG END DETECTION 64
6.13. RACK PHASE DIFFERENCE 65
6.14. SPECIAL OPERATIONS 66
6.15. EMERGENCY OPERATIONS 73

7. OPERATING SEQUENCE 76
7.1. BEFORE START-UP 76
7.2. STARTING UP 77
7.3. LEG HANDLING 78
7.4. PLATFORM HANDLING 83
7.5. PRELOADING 85
7.6. STOP OF JACKING OPERATIONS 85

8. MAINTENANCE MECHANICAL SYSTEM 86
8.1. JACKING UNIT 86
8.2. SHOCKPADS 87
8.3. JACKING FRAME 87
8.4. MAINTENANCE INTERVALS 88

9. MAINTENANCE ELECTRICAL EQUIPMENT 89
9.1. PREVENTIVE MAINTENANCE 89
9.2. GENERAL GUIDELINES FOR MAINTENANCE 89
9.3. HMI, PLC AND SOFTWARE 91
9.4. BEFORE FIRST OPERATION 92
9.5. PROLONGED SHUTDOWN 94

APPENDIX A **Mechanical arrangements**
APPENDIX B **Weight summary**
APPENDIX C **E&I drawings and diagrams**
APPENDIX D **E&I equipment data**
APPENDIX E **Utility consumption**
APPENDIX F **Lubrication and other liquids; datasheets**

1. INTRODUCTION

This document describes the operation and maintenance procedures for the Jacking system GLL-50/6, designed and build for elevating and lowering the Jack-up platform and the legs of the GMS Enterprise.

1.1. ABBREVIATIONS

The following abbreviations are used in this manual

ABS	American Bureau of Shipping
AC	Alternating Current
BCU	Brake Control Unit
CC	Control Cabinet. Electrical cabinet with PLC's and inclinometer
CCD	Central Control Desk with integrated WinCC workstation
DP	Dynamic Positioning System (by others)
ESD	Emergency Shut Down
FAT	Factory Acceptance Tests
HMI	Human Machine Interface (WinCC visualization system)
IEC	International Electro technical Committee
I/O	PLC in- and outputs
IP	Ingress Protection
LCP	Local Control Panel
NC	Normally closed
NO	Normally open
OS	Operation System
PLC	Programmable Logic Controller
POS	Process Override Switch
PTC	Positive Temperature Coefficient
RMS	Root Mean Square
RPD	Rack Phase Difference
RPM	Revolutions per Minute

1.2. CONTACT DETAILS / SERVICE REQUESTS

For service requests, inspections and spare parts please contact:

GustoMSC Customer Service Department

Phone: +31 10 28 83 000

Emergency Helpdesk: +31 10 28 83 333

customerservice@gustomsc.com

Or refer to:

www.GustoMSC.com for relevant telephone numbers

For easy reference, please include the following information in the request:

- Hull name
- GustoMSC part reference number / tag number (in case of spare parts or damage to components)
- Detailed description of the problem (for alarm/warning list access, see Section 5.10)

1.3. REVISIONS

Revision 0

Initial issue. Appendices will be updated after SAT.

2. SAFETY PRECAUTIONS

This section deals with health, safety and environmental aspects that may result from the use of the jacking system. It also deals with the safety aspects that can follow from foreseeable misuse or abuse of the installation.

In this instruction manual the following symbols are used to denote the several aspects:

Tip

Advises and suggests the operator to perform specific tasks and operations in an easier and simpler manner

Warning

Warns for possible damage to the installation or the environment if the operator does not follow the instructions carefully

Stop

Warns for possible injury to the operator if the operator does not follow the instructions carefully

2.1. GENERAL SAFETY ASPECTS


Tip

- Distribute this instruction manual among all personnel operating or maintaining the jacking system.
- Make sure that all instructions are read and clearly understood.
- Make sure that personnel comply with all relevant rules and legislation regarding health, safety and environmental aspects.
- Maintain the jacking system, spare parts, machinery and tools as described in this manual and with good workmanship.
- Keep the jacking system and its environments clean and tidy.
- The guarantee expires when:
  - The instructions in this manual were not followed.
  - The jacking system was overloaded or operated not conform this manual.
  - The jacking system was modified without prior consent of GustoMSC B.V.
  - Non-genuine spare parts were used.
- Maintain a log, noting and dating all inspections, maintenance, repairs, adjustments, test results and exchange of parts.
- Maintain a log, noting and dating all failure reporting, the cause of the failures and the remedy.
- Use solvents sparingly. Use of non-recommended solvents can cause damage to parts. Only use recommended solvents.
- Only use recommended lubricants, tools and test equipment or permitted alternatives.

Warning

- Only use the jacking system for its intended purpose.
- Personnel authorized to operate or maintain the jacking system must be qualified to perform their respective tasks.
- Personnel authorized to operate or maintain the jacking system must be informed regarding special instructions and responsibilities.
- Personnel authorized to operate or maintain the jacking system must inform their superiors regarding modifications in the jacking system.
- Personnel authorized to operate or maintain the jacking system must inform their superiors regarding operational changes they experience e.g. increased noise level.
- Lubricants and gear oil may never be spilled overboard.
- Old lubricants and exchanged gear oil must be processed in an environmentally accepted manner according environmental legislation.
- Personnel are obligated to operate the jacking system carefully and cautiously. It is to be expected that personnel operates the jacking system and acts with care for its own safety, health, and well being and for that of others.
- Personnel is obligated to:
  - Operate and handle machinery, tools, dangerous goods and auxiliary gear in a professional and correct manner.
  - Make use of the distributed safety gear in the correct manner and return them in the appointed location after use.
  - Never modify, bypass or remove safeguards from the machinery.
  - Report dangerous situations and near misses to their superiors.
  - Cooperate to support a healthy environment.
- This manual only describes the checks and operation of the jacking system.

Stop

- Modifications to the system shall only be made by GustoMSC B.V. Only genuine spare parts delivered by GustoMSC B.V. shall be used. Unauthorized modifications to the system and/or use of spare parts not delivered by GustoMSC B.V. will immediately end the guarantee of the jacking system and disclaim responsibility of GustoMSC B.V. in case of damage or accident.
- Always wear the mandatory safety gear when performing operational, maintenance or repair tasks.
- Always make sure that nobody is present within the danger zones of moving parts of the jacking system during the operation of the jacking system.
- Always ensure that it is impossible to switch the jacking system on during maintenance and repair of the jacking system.
- Never work on or in the vicinity of live parts unless it is impossible to perform the task required in another way.
- The settings of safety related equipment may not be modified without written consent of GustoMSC B.V..
- Personnel working on or in the vicinity of live high voltage parts, i.e. parts conducting over 30 V rms or 50 DC, must be extremely cautious. Always appoint a watchman. Use a padlock to lock the main switch in the “off” position.
- Welding on any part of the jacking system is not allowed without written consent of GustoMSC B.V..

2.2. SPECIFIC SAFETY ASPECTS

Warning

- All personnel involved in operating the jacking system should be informed regarding the higher risk, special instructions and special circumstances prior to every operation.
- Adjustments and parameters may never be altered, unless it is disclosed in this instruction manual.
- The prescribed maintenance tasks and checks disclosed in this instruction manual must be performed.
- In case of accidental loads above the design loads of the jacking system (i.e. punch through), the system should immediately be inspected for damage before continuing the operation.
- If cracks or damage to parts of the jacking system are observed, the jacking system may not be utilized anymore until the defect parts are exchanged or repaired or after approval of the Class society or GustoMSC B.V.
- If failures are observed, the operation must be ended as soon as possible using a controlled stop. The jacking system may not be restarted unless the failure is remedied.
- The POS (Position Override Switch) functions on the Central Control Desk should be handled with great care. Misuse of these functions can cause severe damage to the system.

3. DESIGN CONDITIONS

3.1. JACKING CAPACITIES

The jacking system capacities are as follows:

Table 3-1: Jacking capacities

Operation		***ABS load case***	***Capacity per jacking unit [mt]***	***Capacity per leg [mt]***
Normal Effective Jacking	*Active*		*90*	*1620*
Preload Holding (average)	*Passive*	*Maximum normal holding load*	*153*	*2754*
		Maximum severe storm holding	*204*	*-*
Leg Handling	*Active*		*20*	*360*
Leg Pulling	*Active*		*83*	*1494*
Leg Pulling	*Passive*		*83*	*1494*

Where the “effective” load is achieved at the rack/pinion interface, where friction in the jacking system bearings and friction between pinion and rack are accounted for. Friction of the leg in its guides will be accounted for by the rig designer.

3.2. DESIGN LIFE

The jacking system design life is based on 500 jacking cycles (20 years with 25 jacking operations per year) and an average jacking cycle as specified in table 3-2.

Table 3-2: Jacking capacities

Operation	***Distance / operation***	***Platform or leg weight***	***Duration***	
	[m]	***[mt]***	***Single operation [min]***	***Total life time [hrs]***
Leg lowering	*40*	*360*	*50*	*417*
Platform lifting	*17.5*	*6480*	*22*	*182*
Platform lowering	*17.5*	*6480*	*22*	*182*
Leg lifting	*40*	*360*	*50*	*417*

3.3. OPERATIONAL LIMITS

3.3.1. Leg loads

In the jacking system the following warning and alarm levels are implemented. These alarm levels are fixed and cannot be adapted.

Table 3-3: Operational load limits

	Capacity / leg [mt]
Speed ramp up / ramp down	
Warning	*+/- 1663*
Alarm	*+/- 1863*
Constant speed	
Warning	*+/- 1582*
Alarm	*+/- 1782*
Static (not moving)	
Warning	*+ 2754 (*)*
Alarm	*+ 2954 (*)*

(*): No alarm levels exist for negative static loads (leg pulling)

In addition to the leg load limits as specified above, individual load limits for individual E-motors (alarm at 153 t equivalent pinion load, only in effect while motor running) and individual shock pads (warning at 500 t) are implemented as well. In normal operations the control system makes sure that these limits will not be reached.

3.3.2. Leg extensions

The following warnings and alarms are set for the leg extensions.

Table 3-4: Operational limits – leg extensions

Description	***Leg extension***
Upper limit (leg lowered)	
Warning	*79 m*
Alarm	*80 m*
Lower limit (leg retracted)	
Warning	*0.2 m*
Alarm	*0.05 m*

Warning

Leg extension warning and alarm levels are based on zero leg extension defined as the location of the leg limit switch. If the leg extension is reset at a different location the software warnings and alarms no longer prevent clashes.

3.3.3. Rack phase difference

Warning and alarm levels for the rack phase difference are set as follows.

Table 3-5: Operational limits – rack phase difference

Description	***Total RPD***	***Displayed on screen***
Rack phase difference		
Warning	*70 mm*	*35 mm*
Alarm	*78 mm*	*39 mm*

3.3.4. Inclinometer angles

Warning and alarm levels for the platform inclination angles are set as:

Table 3-5: Operational limits – platform inclination angles

Description	***Platform inclination***	
Platform inclination angles	*Trim*	*Heel*
Warning	*0.28 °*	*0.28 °*
Alarm	*0.30 °*	*0.30 °*

Only if in Autolevel mode (see section 6.7), exceeding the above alarm levels will cause an ESD stop. If not in Autolevel mode, alarms are suppressed (Process Override Switch).

3.4. VELOCITIES

The Jacking system is electrical Variable Speed driven, which means that the velocities can be set between zero speed and maximum speed. The following maximum speeds apply:

Normal jacking: 0.8 m/min
Leg handling: 0.8 m/min


Tip

During leveling of loads over the four legs and during passive pre-loading it is strongly advised to work at low speed (up to 0.2 m/min)

3.5. ENVIRONMENTAL CONDITIONS

The jacking system is designed for an offshore environment with the following conditions:

Maximum ambient temperature (summer):	+35 ºC
Minimum ambient temperature:	-10 ºC
Steel design temperature:	-10ºC
Relative humidity:	98% at 20 ºC

The VSD cubicles will be placed in a heated and air-conditioned room, with a temperature range as follows:

Maximum ambient temperature:	+ 30 ºC @ 50% RH
Minimum ambient temperature:	+ 20 ºC @ 50% RH

Indoor electrical cabinets are located in air conditioned and heated rooms. Maximum room temperature should never exceed 45 °C.


Tip

- For successful jacking system operation HVAC system should always be operational in cabinet rooms, and cabinet doors should be closed.
- This applies also for the system in ‘OFF’ situation (see section 6.3) as the subsystems in the cabinets remain powered and need closed doors and HVAC.

4. SYSTEM DESCRIPTION

4.1. GENERAL

The jacking system is built for a platform with four legs. The legs are numbered from 1 to 4; each leg consists of three chords A, B and C. Each chord is driven by a set of 6 electric variable speed motors with gearboxes attached, built together in a jacking frame.

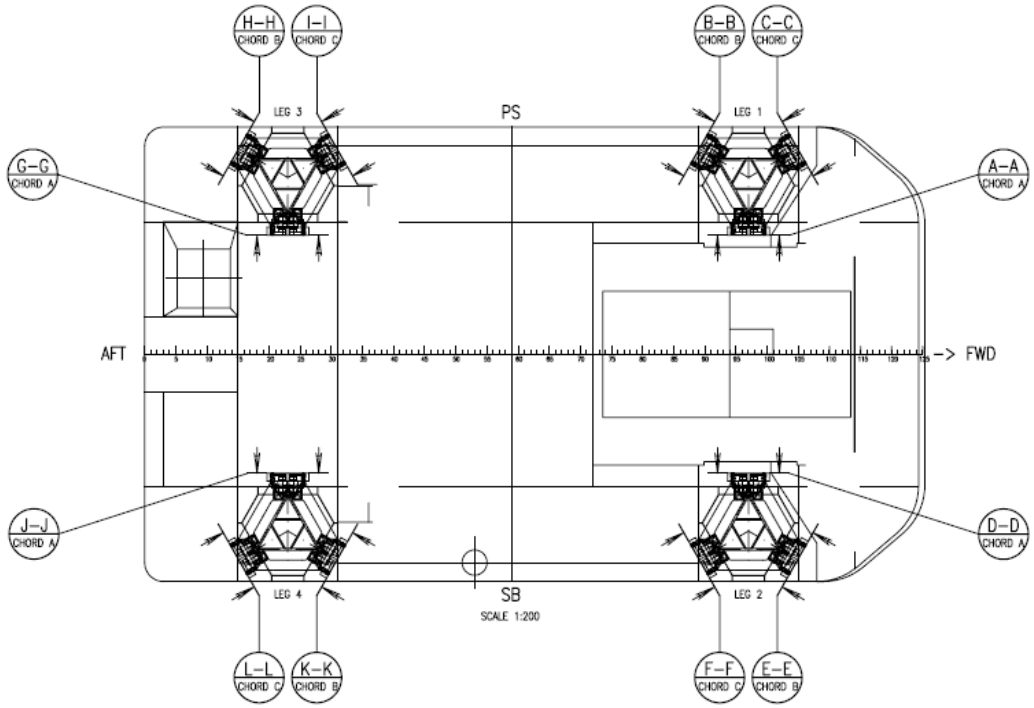


Figure 4-1: Overview of the platform

A jacking unit represents all equipment connected directly to one gearbox which is driving the pinion. Jacking units are numbered, e.g. jacking unit 7-2. The first number corresponds with the motor number; the second number represents the leg number. Knowing that each chord has 6 motors, the 7th motor is the first motor of chord B, see figure 4-2.

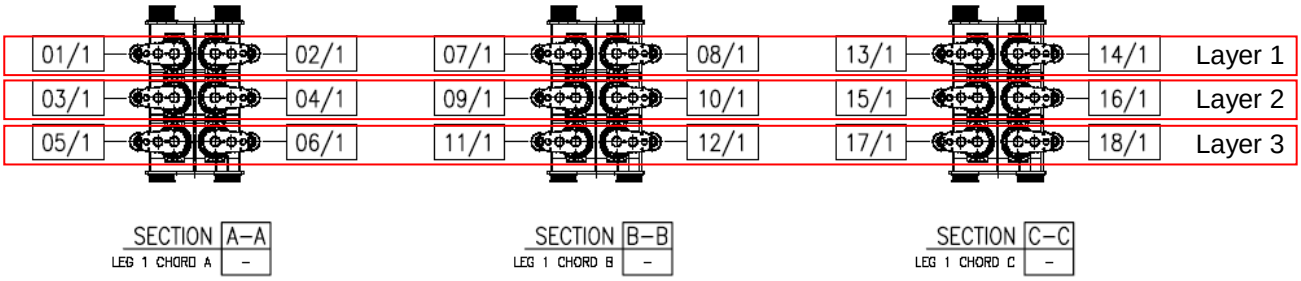


Figure 4-2: Overview of the jacking unit numbering and layer numbering

Each VSD cabinet controls all motors within one layer. A layer is the group of jacking units that are installed on the same level in the jacking frames with the associate VSD cabinet, see figure 4-2. The chords are divided into three separate layers. Each VSD cabinet contains 24 inverters, six for each leg. For example: the motors controlled by VSD3 (layer 3) are: M5, M6, M11, M12, M17, M18 for all legs.

4.2. DESCRIPTION OF THE MECHANICAL SYSTEM

4.2.1. General

The mechanical system consists of the following:

- 3 off Jacking frames per leg with:
  - 4 off shock pads per frame
  - 6 off jacking units per frame

The jacking units consist of the following:

- Gearbox assembly
- Pinion, assembled to the gearbox
- E-motor assembly (described in section 4.3.2)

4.2.2. Jacking frames (12 off)

The jacking frame is a box-like steel structure with supports for the shock pads and guiding pads on top and at the bottom. The guide pads are part of the jacking frame. They guide the jacking frame and thus the jacking units along the chord of the leg. The guides are removable to allow installation of the jacking frame around the chord and to facilitate replacement when worn out.

The jacking frame structure is welded from grade 355 carbon steel plates. The guide wear plates are made from Brinar 400 steel.

The jacking frames and units fit in the (fixed) jacking structure welded on deck of the platform.

Removal of the individual jacking units, frames and individual parts is possible, provided enough free space is allocated for around the units.

4.2.3. Shock pads (48 off)

The jacking loads have to be transmitted from the (floating) jacking frame to the (fixed) platform. Shock pads are located on the upper and lower side of the jacking frame to make the horizontal displacement possible.

The upper shock pads are equipped with load measurement, to enable chord load measurement while the jacking system is on brakes and/or off-line.

The characteristics of each of the upper shock pads are as follows:

- Operational load 270 t
- Maximum load 664 t

The individual loads of the upper shock pads are monitored by the jacking system control system and a warning or alarm message is generated when the individual shock pad load limits are exceeded.

The lower shock pads are equipped with load measurements to enable chord load measurement while leg handling and to provide indication that the spud can has reached the seabed.

The characteristics of each of the lower shock pads are as follows

- Operational load 81,5 t
- Maximum load 364 t

4.2.4. Pinions (72 off)

The pinion, model M50, engages with the high strength steel rack. The rack shall be greased thoroughly before / during operation. The pinion is supported in the gearbox by spherical bearings inside the lantern piece. The end- bearing needs to be adequately greased (see section 8).

Pinion technical data:

- Module: 50 mm
- Pressure angle: 27 degrees
- Number of teeth: 7
- Pinion width 200 mm
- Pinion weight See gearbox, included in gearbox weight, see Section 4.2.5

4.2.5. Gearbox (72 off)

The gearbox, model U265, is a totally enclosed unit and shall be filled with oil by owner prior installation. Left-hand and right-hand units are identical. The gearboxes are equipped with:

- Holes for fitting lifting lugs (M30 and M16)
- Oil fill- and drain plugs
- Oil level dip stick
- Inspection access holes
- Access for input shaft, with receptor for 19 mm Allen key, for manual gearbox rotation (for installation purposes)
- Lantern piece with spherical roller bearings

Gearbox technical data:

- Model U265
- Gear ratio: 1:1965.00
- Dynamic output torque: 150 kNm
- Static output torque: 350 kNm
- Output speed: 0.73 rpm
- Oil quantity: 135 lit +/- 10%
- Gearbox weight incl. pinion (without oil) 2531 kg
- Oil type: Mobilgear SHC XMP 320 with ISO VG320 viscosity (other types to be approved by GustoMSC B.V.)

4.3. DESCRIPTION OF THE E&I / CONTROL SYSTEM

4.3.1. Overall system

The system is based on individually Variable Speed Drive (VSD) controlled motors. The system comprises of three VSD panels, each equipped with a DC-bus. Each bus feeds a group of inverters, driving the jacking motors. Each DC-bus has a 12 pulse in feed, which consists of two 6-pulse rectifiers, and one braking chopper to absorb reverse power.

The design of the system is in accordance with European manufacturer's offshore standard, class requirements and relevant IEC standards.

The system is suitable for operation in non-hazardous areas only.

The systems main power supply is,

- Voltage: 690V, 3 phase, floating (3-wire, no neutral)
- Frequency: 50Hz.

Additional power supply is required for auxiliary services and control are:

- 415V, 3 phase, 50Hz
- 220V, Emergency power, 50Hz, floating, no neutral
- 220V, Uninterruptable power, 50 Hz, floating, no neutral
- 220V, Normal power, 50Hz, floating no neutral

Each motor is equipped with a brake and encoder. The brake is used for holding; the encoder is to determine the actual motor speed. For each leg one motor is equipped with an over speed sensor.

The speed encoder and brake signals are led to the VSD cubicles, where power and brakes are controlled.

Overall functionality is combined in the Control Cabinet, where two PLC's are located (one standby PLC). HMI screens on the central control desk, and local functions on the Local Control Panels function as operator interface.

Main power is distributed by transformers to the VSD cubicles, where brake energy is absorbed by the brake resistors.

The ESD functions are separately implemented and are hard-wired connected to ESD push buttons and over speed sensors.

The different cabinets communicate over a network based on the Profibus protocol type.

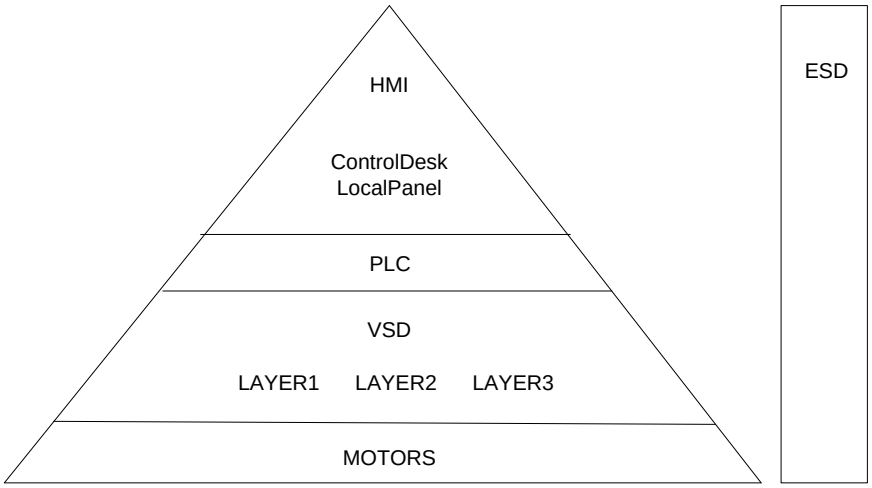


Figure 4-3: Architecture of control system.

The various components of the jacking and control system are described in the next sections.

4.3.2. Motors (72 off)

The motors are AC cage-induction type, IP 56, totally enclosed, flange-mounted with fail-safe (electrically released, spring loaded) electromagnetic brake. Motor cooling and duty are rated to accommodate ambient temperatures and all operational cases. Insulation class F.

Each motor is equipped with an internal heater. The leg motors (18 per leg) have the following power rating:

- 117 Nm (18 kW) S2-60 min.
- 143 Nm S2-30 min.
- 180 Nm S2-5 min.

4.3.3. Brakes (72 off)

Each motor and gearbox combination is equipped with an electro-mechanical brake. Each brake is equipped with an internal heater. The brake will disengage when the DC coil is powered. In normal operation the brakes are only used as a stationary brake. The brake is a Pintsch Bamag SFB 16/21-SH with a nominal braking torque of 210 Nm.

4.3.4. Encoders (+overspeed protection) (72 off / 4 off)

The encoder on every motor provides the feedback (motor speed) for the jacking control system. For each leg one motor is equipped with an over speed switch. The over speed switch will stop the jacking system if severe over speed is detected (independent from the software settings).

4.3.5. Transformers (3 off)

Each VSD cabinet is powered by a 690/448/448 V Dy5d0 450 kVA transformer with dual secondary windings. Each transformer has an anti condensation heater and PTC sensor for temperature monitoring.

4.3.6. Brake resistors (3 off)

A brake resistor is connected to the brake chopper. The energy that is generated by lowering the platform or a leg is dissipated by this resistor. The resistor is built in a stainless steel enclosure. A cooling fan is mounted in the frame to cool the resistor.

4.3.7. VSD cubicles (3 off)

The system comprises three VSD cabinets, one for each layer. Each VSD cabinet consists of two rectifiers in a 12 pulse configuration and 24 inverters. Each inverter is connected to a motor with encoder. The brakes of the motors are controlled from this cabinet as well. The VSD cabinets are air cooled. A chopper is installed in each VSD cabinet for dynamic braking, e.g. if the platform is lowering.

4.3.8. Control Cabinet

In the Control Cabinet the PLC system takes care of all logical operations, except for the closed loop controls for the motors. The PLC system also includes the communication hardware to accommodate remote I/O and the HMI system. Two PLC’s with software redundancy are connected. In case

of a problem in one of the PLC's the other one can take over. With the key switch in the cabinet the selection can be made which PLC is active.

4.3.9. Local control panels

Near each leg a Local Control Panel is available to control the jacking system locally.

4.3.10. Central Control Desk

The system is controlled at the Central Control Desk by an operator. All main functions are controlled and monitored by buttons, joysticks and indication lamps. Two head-up screens and a keyboard are integrated in the CCD. Some special functions are activated on these screens and an overview of the actual values is presented. In case of an alarm or a warning, a message will appear on one of the screens. A third screen next to the joysticks gives basic information about leg load and inclination angle.

4.3.11. Inclinometer

The jacking system is supplied with one electronic inclinometer located in the Control Cabinet.

4.3.12. Communication

The distributed electronic systems are interconnected by an optical link, communicating via the Profibus protocol in a ring arrangement. This net topology gives redundancy. The ring can be interrupted once without loss of functionality. If an interruption occurs a warning message is generated.

4.3.13. Interfaces with other systems

See the table below for the general description of the interfaces with external systems and switches.

VSD Layer 1			
I/O	**Interface Type**	**System**	
Digital Input 0 24v	CONTACT NO	Leg 1 lower limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 1 upper limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 2 lower limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 2 upper limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 3 lower limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 3 upper limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 4 lower limit alarm	
Digital Input 0 24v	CONTACT NO	Leg 4 upper limit alarm	

Control Cabinet (CC)			
I/O	**Interface Type**	**System**	
Relay output	CONTACT NO/NC	Leg 1 Running Motor heating on/off	
Relay output	CONTACT NO/NC	Leg 2 Running Motor heating on/off	
Relay output	CONTACT NO/NC	Leg 3 Running Motor heating on/off	
Relay output	CONTACT NO/NC	Leg 4 Running Motor heating on/off	
Analog output Active	4-20mA	Leg 1 extension to DP	
Analog output Active	4-20mA	Leg 2 extension to DP	
Analog output Active	4-20mA	Leg 3 extension to DP	
Analog output Active	4-20mA	Leg 4 extension to DP	
Analog output Active	4-20mA	Leg 1 load to vessel	
Analog output Active	4-20mA	Leg 2 load to vessel	
Analog output Active	4-20mA	Leg 3 load to vessel	
Analog output Active	4-20mA	Leg 4 load to vessel	
Relais output	CONTACT NO/NC	Alarm to vessel	
Relais output	CONTACT NO/NC	Shockpad active to vessel	

5. HMI ENVIRONMENT

Upon startup of the Jacking System, the WinCC runtime environment will be started up automatically. After login (see section 5.7) the system can be used to control and monitor the jacking process. This section describes how to use the WinCC runtime environment for monitoring and controlling the jacking system.

5.1. COLOR DEFINITION

The colors used for the visualization are selected to increase contrast between items and status presentation. Within the screens, 16 basic colors are defined. Table 5-1 gives an overview of the colors used.

Table 5-1: Color definition

Color		*If used in symbol*
Red		Alarm
Green		Run
Blue		Overruled
Yellow		Warning

5.2. SCREEN LAYOUT

The WinCC screen lay out can be divided in three areas:

- The overview area. Here you can choose the different screens
- The workspace area. Here the jacking process can be monitored and controlled
- The button area. OS functionality can be controlled from this bar.

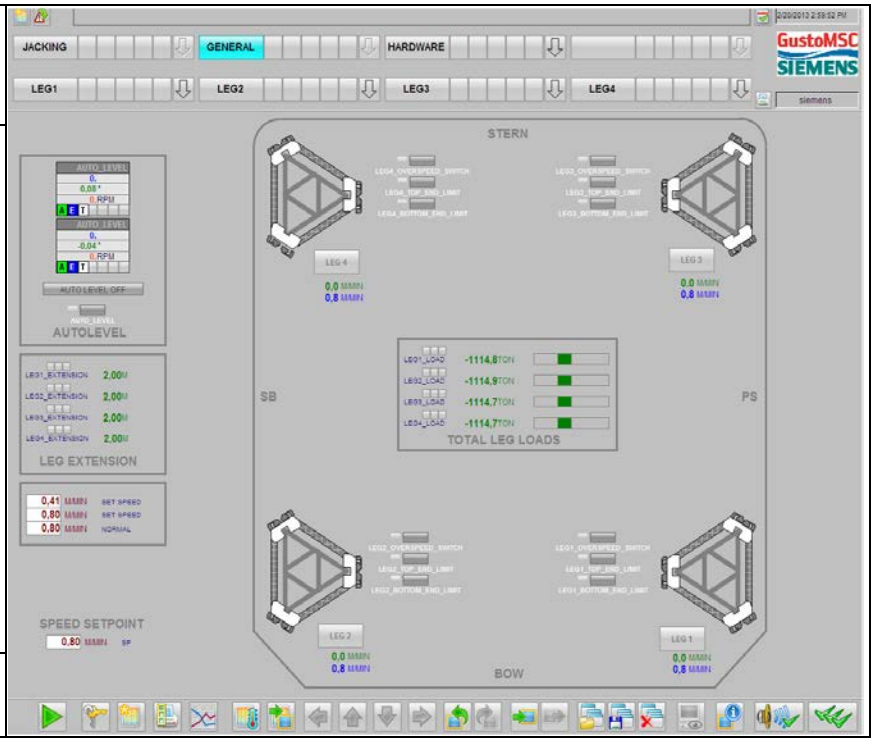
Overview area	
Workspace area	
Button area	

Figure 5-1: Screen layout

5.2.1. Overview area

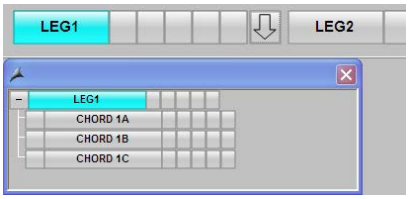
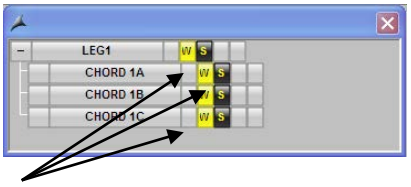
Figure 5-2: Overview area

An area selection button in the overview window represents the platform (group) area.

The HMI screens in the top hierarchy will be selected upon left mouse click.

See the table 5-2 for an overview of the other used symbols and their functionality:

Table 5-2: Description Items in overview area.

Function	*Key*
Message line: Messages (alarms, messages, system messages) are shown here. This line always displays the most recent message	
Message acknowledge button: Button for acknowledging the currently displayed message Also the reset button on the CCD can be used.	
Area selection button: Displays the area picture in the workspace. The button labels correspond to the names of the picture configured in the top level of the Picture Tree Manager. Selected area has background cyan, otherwise gray	
Opens the process window of the Picture Tree Navigator To choose pictures lower in the hierarchy, left mouse click on the lower buttons	 
Loop-in-Alarm (open picture - alarm source): These buttons will lead you to the picture containing the source of the alarm. In this example, The symbols represent the collection of alarms and messages from the leg 1 area. Red : Alarm (system will stop) Yellow: Message (system won't stop. Mostly used for system treshholds) Black : System alarm (mostly fatal alarm, repair needed) Blue : Not used in this system Also see Table 5-7 section 5.11 for details.	
Login: Displays the name of the current user. A mouse click activates the login window. Login name in this example is "Siemens"	

5.3. WORKSPACE

5.3.1. General

Displayed in the workspace are the individual screens of the various areas of the platform. The process is displayed, controlled and operated here. The pictures in the workspace are selected:

- Via navigation buttons and the picture hierarchy (see previous section 5.2.1)
- Via direct picture selection functions that may be configured.

There a two LCD screens available on the CCD. These screens are independent which means different views can be chosen on each screen. In the workspace, area images are displayed for reasons of supervising, control and / or manual operation.

The following screens are available in the workspace:

- General screen, see 5.3.2
- Jacking screen, see 5.3.3
- Leg screen (4x), see 5.3.4
- Chord screen (12x), see 5.3.5
- Hardware screen, see 5.3.6
- Brake test screen, see 5.3.7
- Loadcell screen, see 5.3.8
- Motor Temperature screen, see 5.3.9

5.3.2. General screen

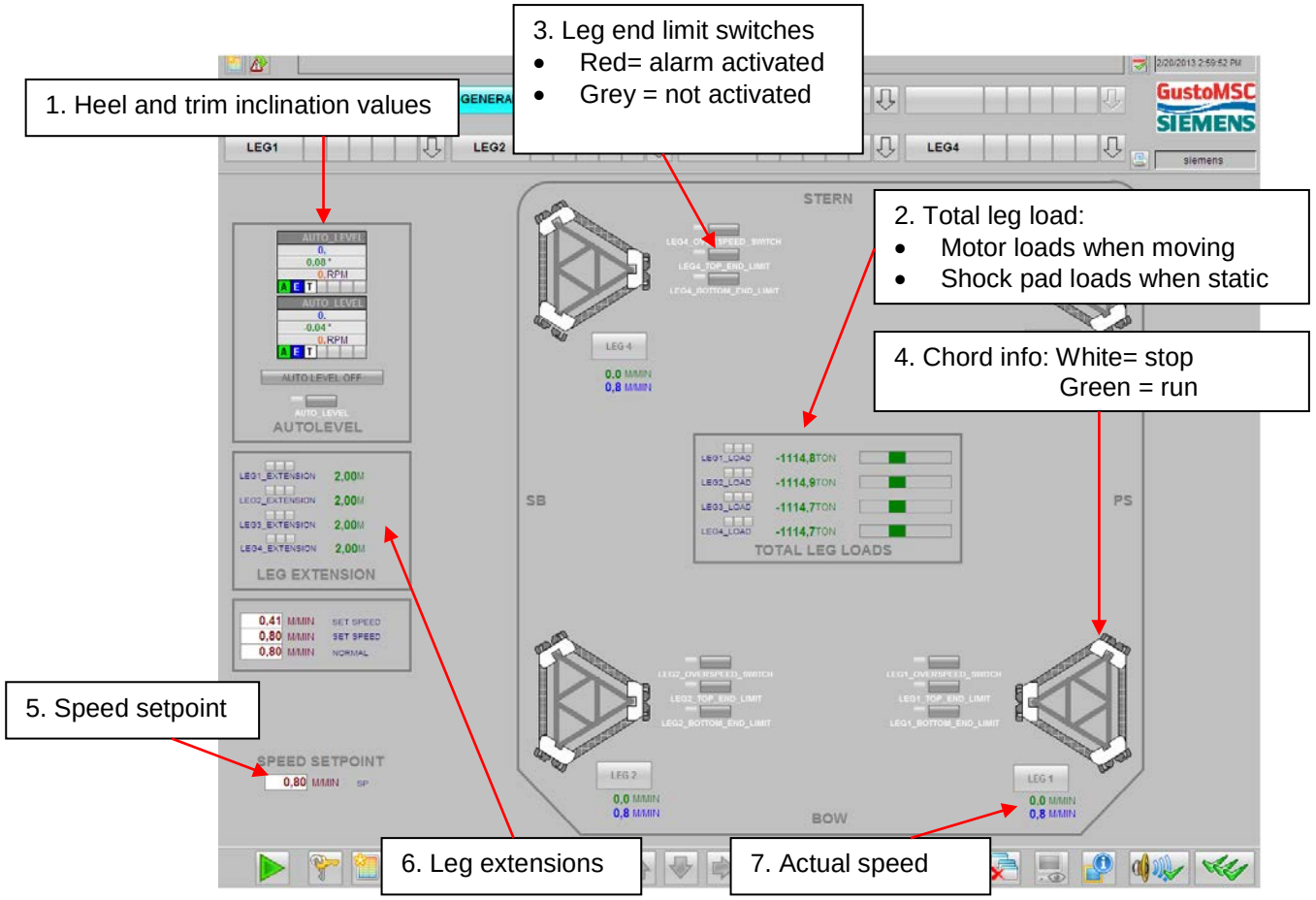


Figure 5-3: General screen

The following information is displayed on the General screen:

1. Heel and trim inclination of the platform.
2. The total leg load (*) displayed in horizontal bar graphs.
3. Leg end limit switches: Status of the leg end limit switches is displayed here.
4. Chord info: Color of the chords indicate if the motors are running or not.
5. Speed setpoint: The speed setpoint that the platform should be moving at.
6. Leg extensions: The individual leg extensions of the legs below the hull. Leg extensions are measured from the point where the legs are zero-ed. Normally zero is when the spud can is flush with the keel.
7. Actual speed: Green color indicates the actual speed; blue color indicates the speed set point.

(*) Remarks on Leg Loads presented:

- When motor brakes are released, the total leg load is derived from the individual motor loads (in metric tons). Presented loads take into account mechanical efficiency losses and present the load at pinion-rack elevation.
- When the motor brakes are set (motors not powered), the total leg load is derived from shock pad loads. Presented loads take into account jacking frame + jacking units deadweight and as such also represent the leg load at pinion-rack elevation.
- Platform handling loads (upward and downward) are presented as positive loads, leg handling loads (upward and downward) are presented as negative loads.
- When leg handling and brakes set, no shock pad load information is available and consequently leg load is presented as zero. It shall be noted that in that case the actual leg load (on the pinions) does not have to be zero (passive leg pulling).

Warning

While floating (leg handling) and brakes are set, leg load is presented as 0, as no (lower) shock pad load data is available.

However actual leg load is not zero. In floating mode the leg load equals leg weight, during leg pulling the load can be higher.

In case the actual leg load is higher than allowable jacking load (as may happen during passive leg pulling), active leg movement is not possible as the system will sense overload as soon as the motors are energized. To reduce the load on the jacking system, follow the procedure in Section 6.14.1 Leg pull override mode.

5.3.3. Jacking screen

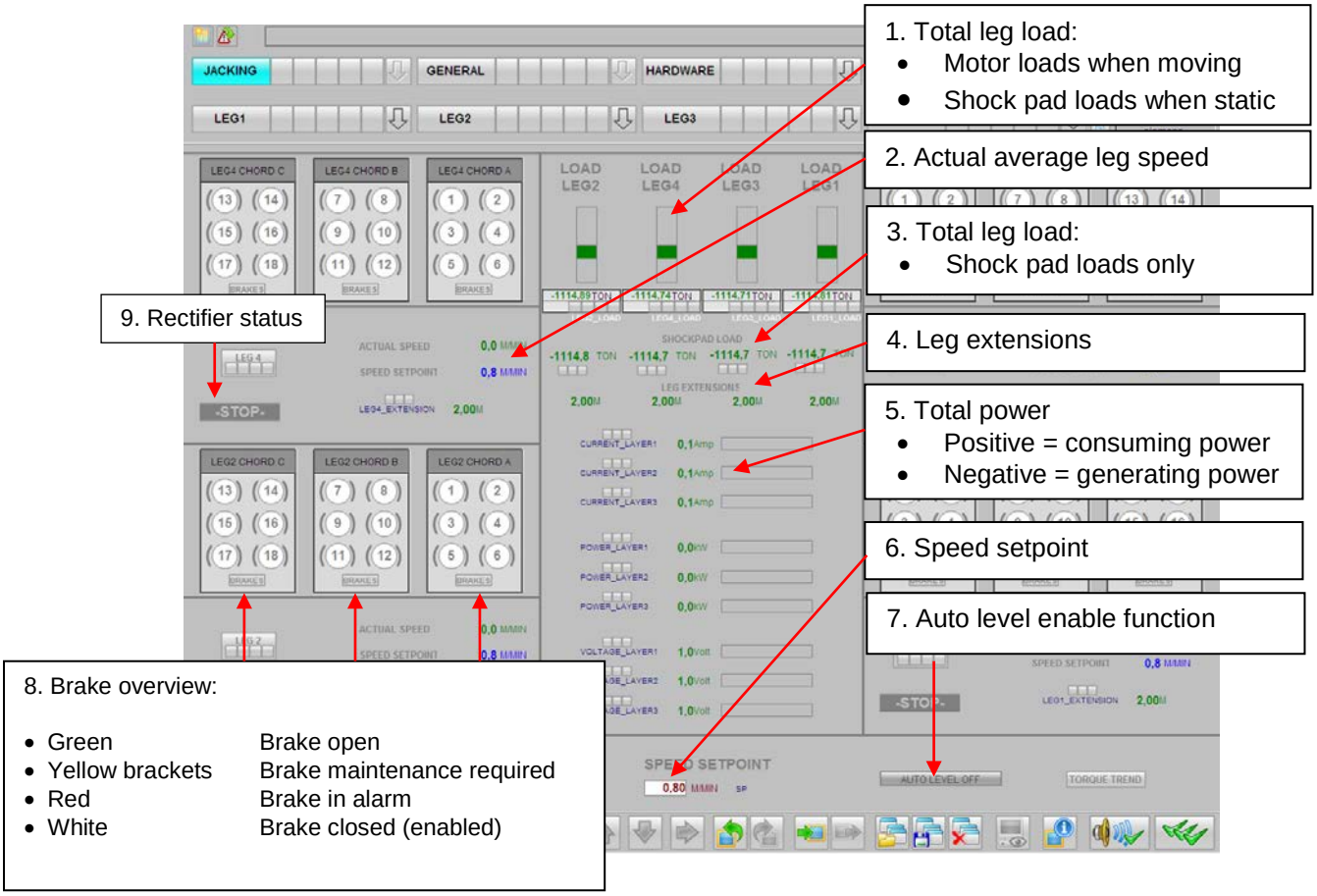


Figure 5-4: Jacking screen

The following information is displayed on the Jacking screen:

1. The total leg load displayed in vertical bar graphs. (*)
2. Actual average leg speed: The average leg speed calculated from the individual motor speeds on one leg.
3. Total leg load as derived from shock pads. Load is always presented when platform handling. When leg handling the value 0 is shown. (*)
4. Leg extensions: The individual leg extensions of the legs below the hull. Leg extensions are measured from the point where the legs are zero-ed. Normally zero is when the spud can is flush with the keel and/or when leg upper limit switches make contact.
5. Total power: The total power that is consumed or generated during leg handling and platform handling. The total power is presented per layer.
6. Speed set point: The speed set point that the platform should be moving at.
7. Autolevel enable function: Shows if the Autolevel function is active or not.
8. Brake overview: One brake overview is given for each leg. Each individual brake is shown.
9. Rectifier status: Stop / Ready (circuit breakers in) / Closed .

(*) see Remark on Leg Loads in section 5.3.2

5.3.4. Leg screen

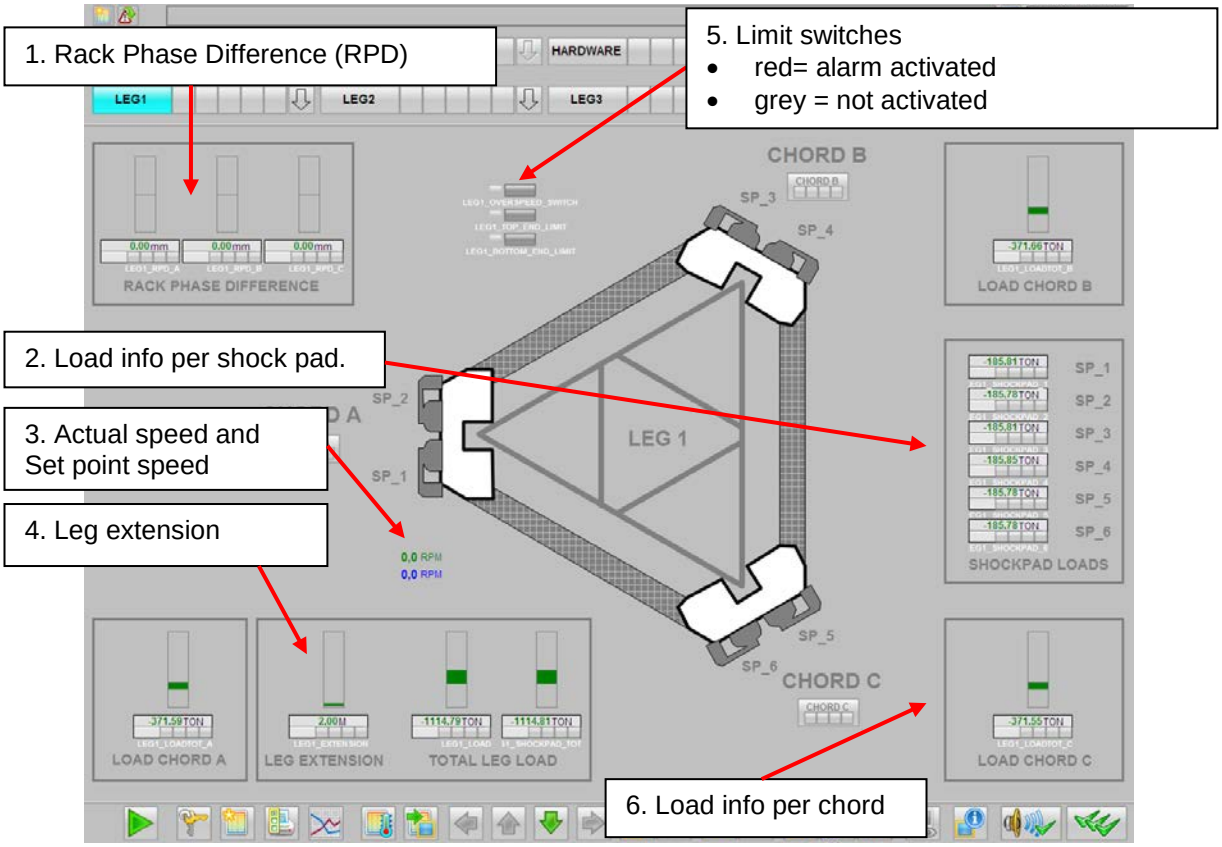


Figure 5-5: Leg screen

The following information is displayed on the Leg screen:

1. Rack phase difference (RPD): Indicates the difference in travel between the three individual leg chords.
2. Load info per shock pad on pinion level: The individual shock pad load value in metric tons. Location of each shock pad number can be seen on leg sketch in the center of the leg screen.
3. Speed set point: The speed set point that the platform should be moving at. Actual speed: Green color indicates the actual speed; blue color indicates the speed set point.
4. Leg extensions: The individual leg extensions of the legs below the hull. Leg extensions are measured from the point where the legs are zero-ed.
5. Leg end limit switches: Status of the leg end limit switches is displayed here.

6. Load info per chord (*): The following values are presented in this block.
   a. Leg load average: The average of 6 motor loads in metric tons per chord; or 0 when static.
   b. Leg load min: The lowest individual motor load for that specific chord or 0 when static.
   c. Leg load max: The highest individual motor load for that specific chord or 0 when static.
   d. Leg load tot: Total leg load of 6 motor loads or the sum of two shock pad loads per chord.

(*) Remarks on Chord Loads presented:

- When motor brakes are released, the total chord load is derived from the individual motor loads (in metric tons). Presented loads do not take into account mechanical efficiency losses between pinion and motor.
- When the motor brakes are set (motors not powered), the total chord load is derived from shock pad loads. Presented loads take into account jacking frame + jacking units deadweight and as such also represent the chord load at pinion-rack elevation.
- Platform handling chord loads (upward and downward) are presented as positive loads, leg handling chord loads (upward and downward) are presented as negative loads.
- When leg handling and brakes set, no shock pad load information is available and consequently chord load is presented as zero. It shall be noted that in that case the actual chord load (on the pinions) does not have to be zero (passive leg pulling).

Warning

While floating (leg handling) and brakes are set, leg load is presented as 0, as no (lower) shock pad load data is available.

However actual chord load is not zero. In floating mode the sum of chord load equals leg weight, during leg pulling the load can be higher.

Chord loads are not monitored so no warning and alarms.

5.3.5. Chord screen

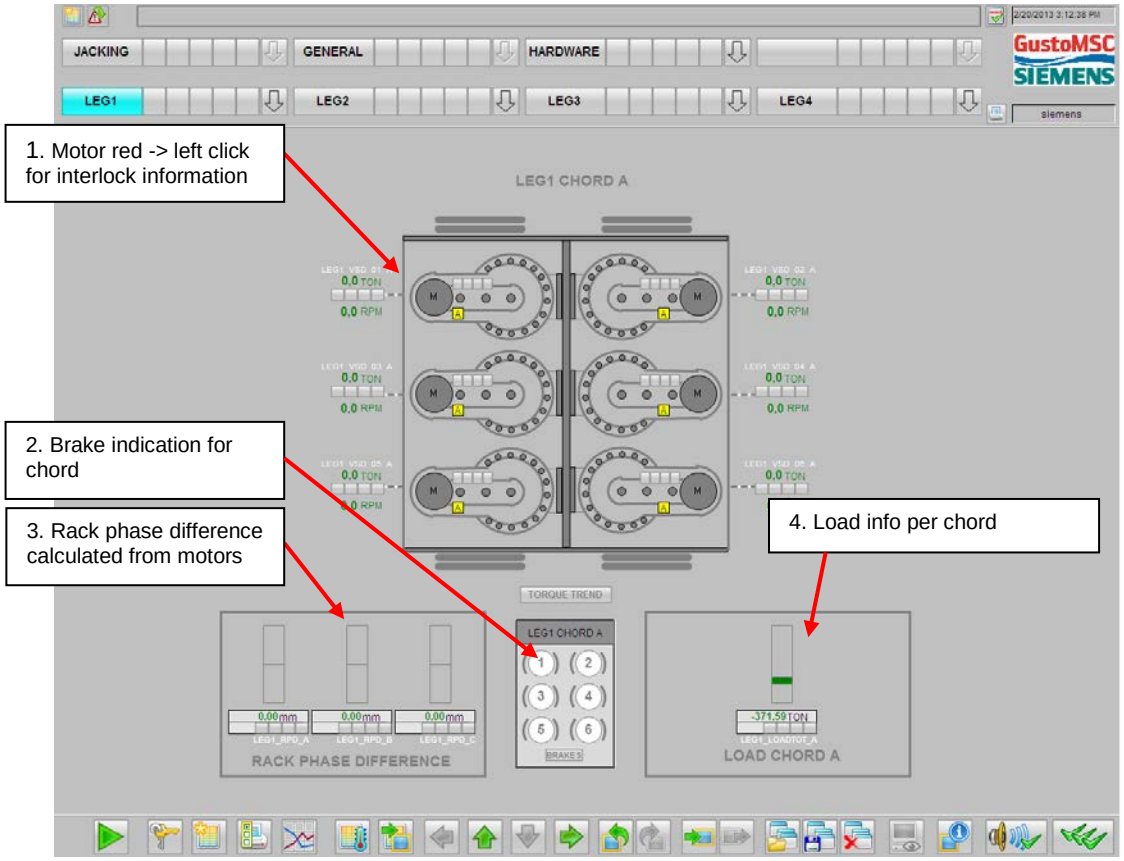


Figure 5-6: Chord screen

The following information is displayed on the Leg screen:

1. Motor red: By right clicking on an individual motor the motor face plate with information for the individual motor is opened.
2. Brake indication: One brake overview is given for each chord. Each individual brake is shown.
3. Rack phase difference: Indicates the difference in travel between the three individual leg chords.
4. Load info per chord (*): The following values are presented in this block.
   a. Leg load average: The average of 6 motor loads in metric tons per chord or 0 when static.
   b. Leg load min: The lowest individual motor load for that specific chord or 0 when static.
   c. Leg load max: The highest individual motor load for that specific chord or 0 when static.
   d. Leg load tot: Total leg load of 6 motor loads per chord or the sum of two shock pad loads per chord. (*)

(*) Refer to the remarks in section 5.3.4 on chord loads

5.3.6. Hardware screen

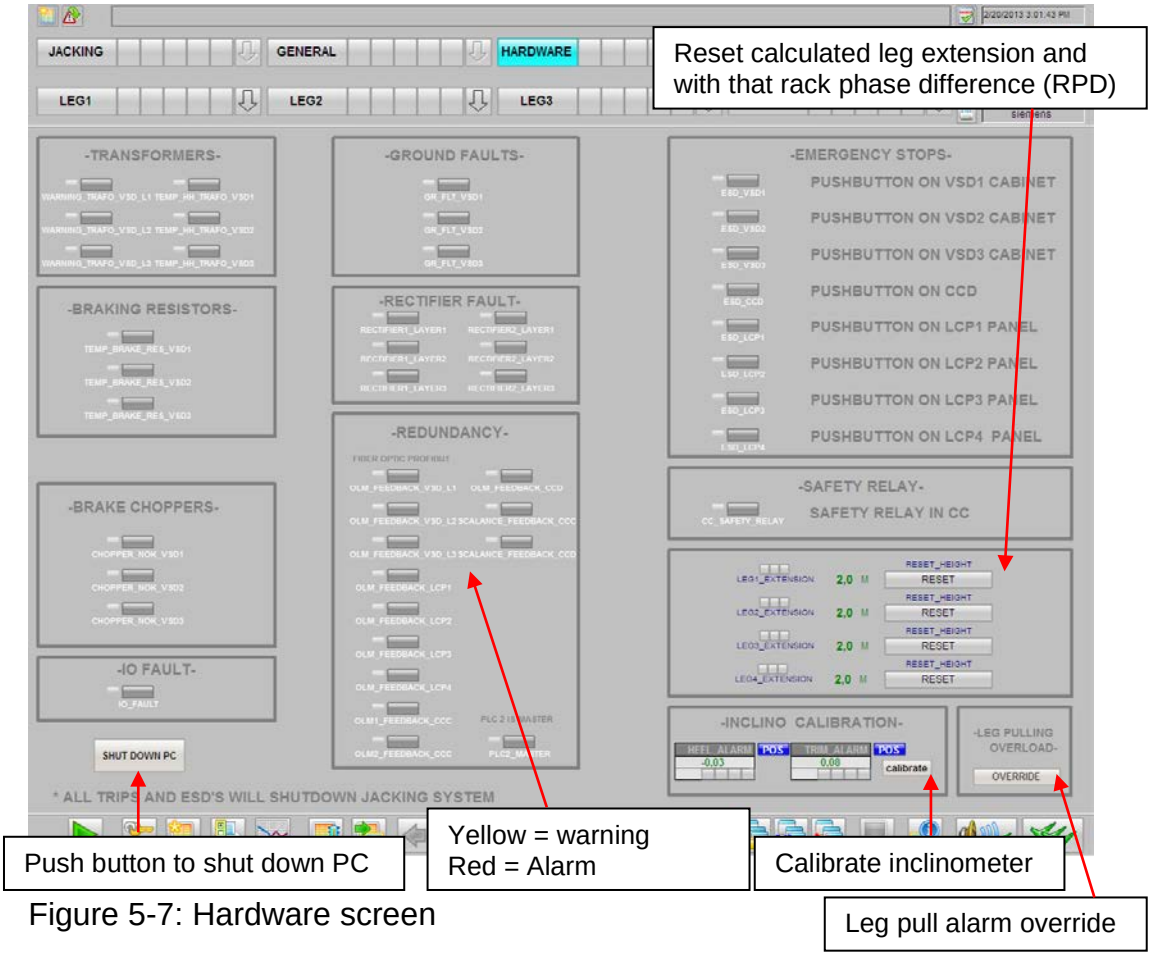


Figure 5-7: Hardware screen

The Hardware screen presents the alarm status of the electrical hardware of the jacking system:

1. Transformer temperature alarm status.
2. Braking Resistors temperature alarm status.
3. Braking chopper general alarm status.
4. I/O Fault: errors from communication network.
5. Ground faults, per layer per rectifier.
6. Rectifier general alarm status.
7. Redundancy: communication ring network status.
8. Emergency status: identification of all ESD stops and their status.
9. Safety relay status.
10. Leg extensions and RPD: reset facility.
11. Inclinometer: calibration facility. POS is shown automatically when not in Autolevel mode, because when not in Autolevel mode, alarms will not lead to an ESD stop.
12. Button to shut down PC for long term system shut down.
13. Leg pull override button, see section 6.14.1.

5.3.7. Brake test screen

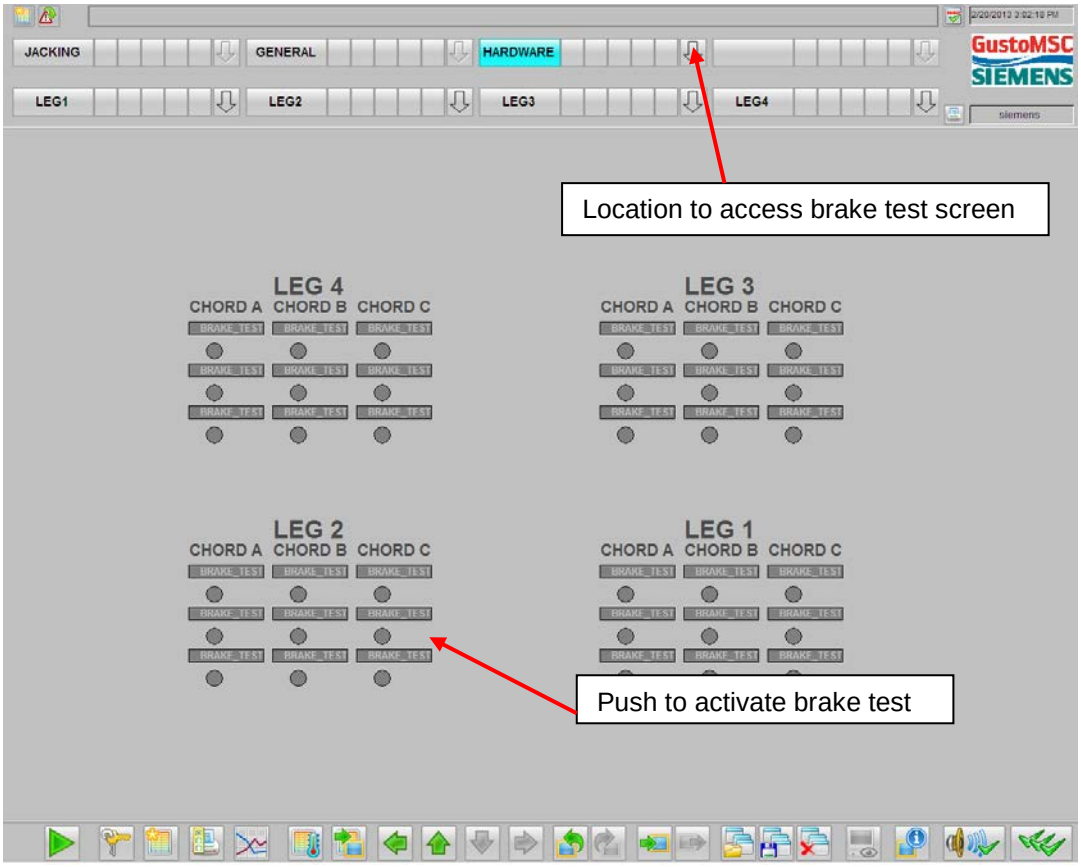


Figure 5-8: Brake test screen

The brake test screen can be accessed with the sub-screen selection tool in de overview area under Hardware.

A brake test is always performed with a set of 2 brakes, the brakes of the opposite motors on a chord. By pressing the button the brakes open, displayed as green. A message is generated confirming that the brakes are opened. If the brakes do not open check the wiring and the brake functionality.

5.3.8. Loadcell screen

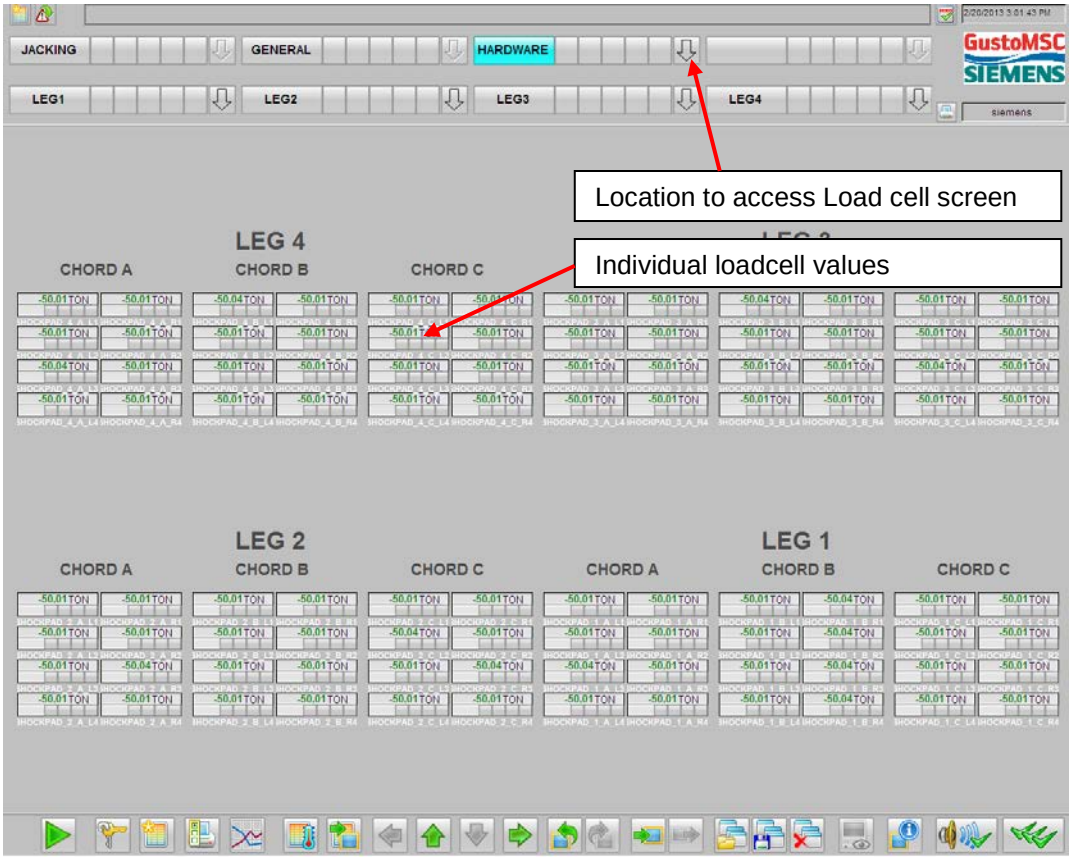


Figure 5-9: Load cell screen

The Loadcell screen displays actual individual loadcell values. It can be accessed with the sub-screen selection tool in de overview area under Hardware.

5.3.9. Motor temperature screen

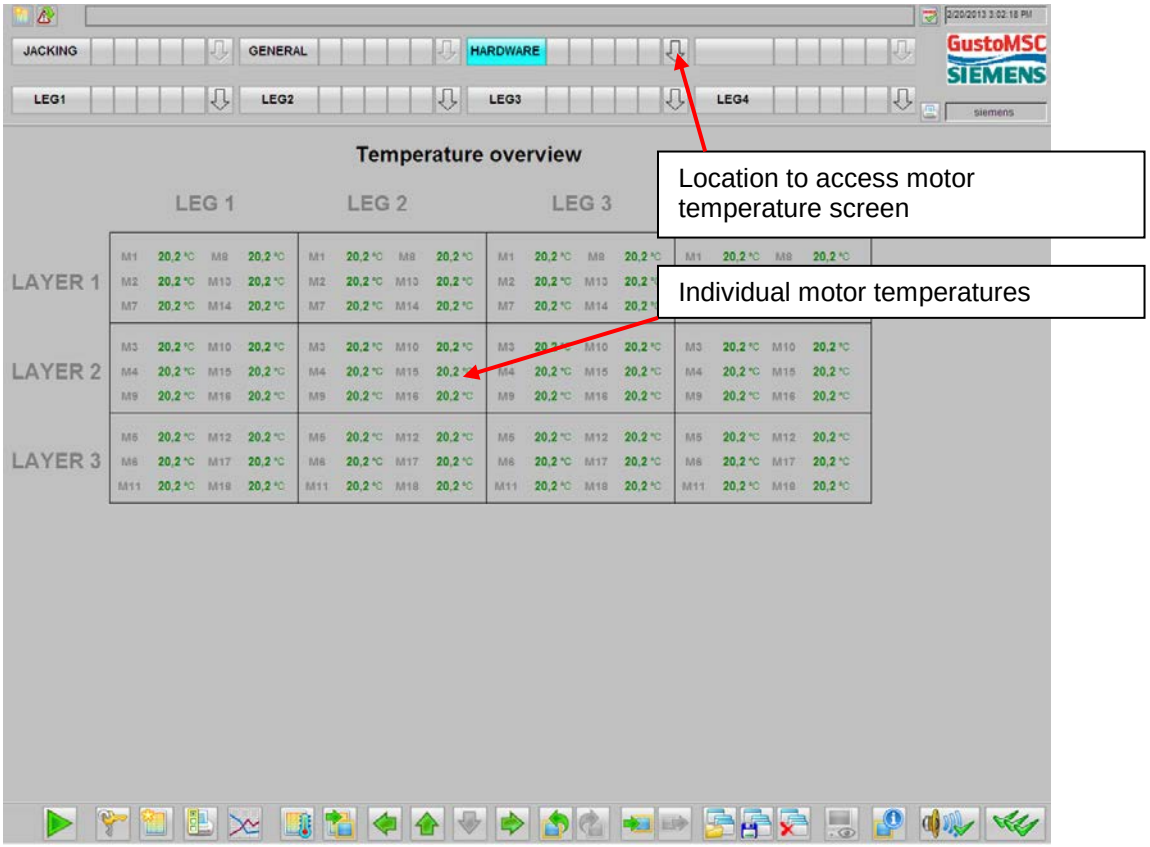


Figure 5-10: Motor temperature screen

The Motor Temperature screen displays actual individual motor temperatures. It can be accessed with the sub-screen selection tool in de overview area under Hardware.

5.4. BUTTON AREA

Displayed in the button area are function buttons. The runtime system defines three sets of buttons. Figure 5-11 presents an overview of the three button key-sets. The explanation is given in Table 5-3. Depending on the authorization level and software some buttons will (not) be available. Disabled buttons are not visible.

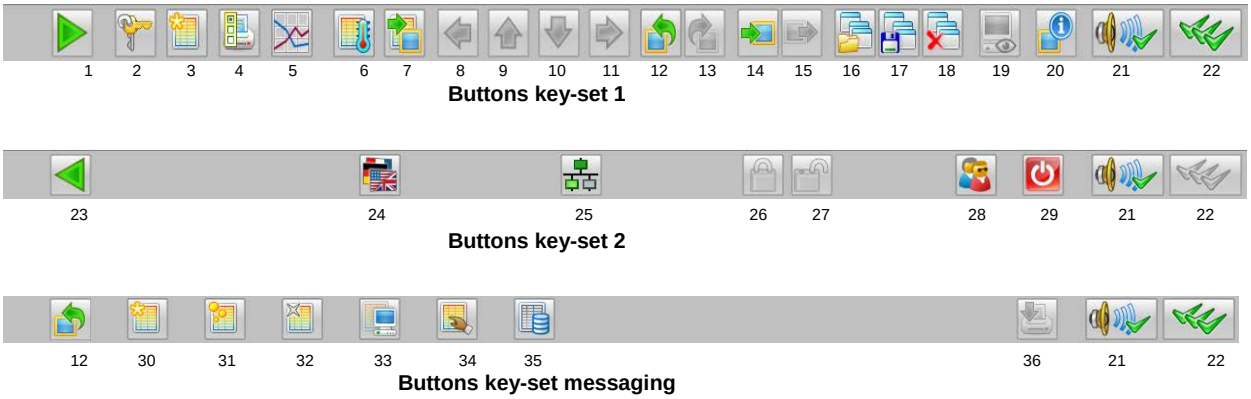
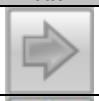


Figure 5-11: Button key sets

Table 5-3: Description of the buttons in button area

NO	*Button*	*Definition*	*Tool tip text*
1		Change to button set 2	Key set change
2		Login	Password
3		Alarm window	Alarm logging
4		Reports	Reports
5		Make trends online	Trend system
6		Navigate directly to Tags	Tag point by tag
7		Navigate directly to pictures	Picture by name
8		Navigation button left	Picture left
9		Navigation button up	Picture up
10		Navigation button down	Picture down

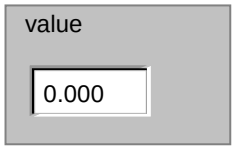
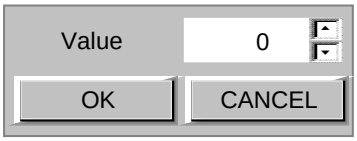
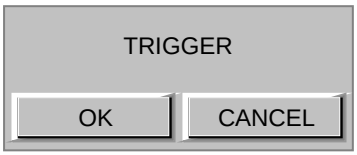
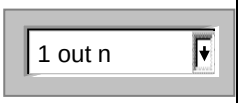
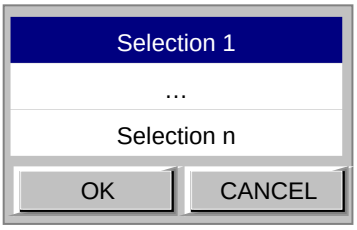
NO	Button	Definition	Tool tip text
11		Navigation button right	Picture right
12		Navigation button previous	Previous picture
13		Navigation button next	Next picture
14		Store picture	Store single picture
15		Restore picture	Restore single picture
16		Load picture composition	Recall saved screen composition
17		Save picture composition	Save screen composition
18		Remove screen composition	Delete screen composition
19		System monitoring	Plant network configuration
20		Picture information	Picture information
21		Acknowledge horn	Acknowledge horn
22		Acknowledge error	Acknowledge error
23		Change to button set 1	Key set change
24		Change language	Change language
25		SFC visualization	SFC
26		Lock messages	(NOT AVAILABLE)
27		Unlock messages	(NOT AVAILABLE)
28		User authorization	User authorization
29		Exit runtime	Exit runtime

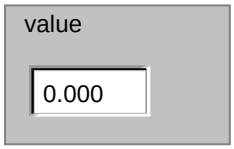
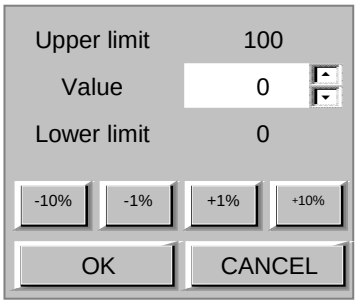
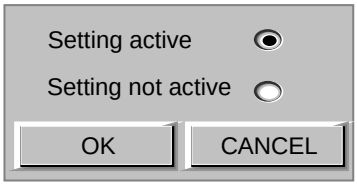
NO	Button	Definition	Tool tip text
30		Incoming alarm list	Incoming alarm list
31		Acknowledged alarm list	Acknowledged alarm list
32		Outgoing alarm list	Outgoing alarm list
33		Process alarms	Process alarms
34		Operation list	Operation list
35		Journal list	Journal list
36		Print	Print (NOT AVAILABLE)

5.5. WINCC OPERATOR INTERVENTIONS

The system is provided with standard graphics that allow the operation to set or modify system settings. This functionality is described in table 5-4 below.

Table 5-4: Operator interventions

Field	*Presentation*	*Function*	*Elements*
Trigger 		Field to operate a trigger ("push-button"). The color of the text indicates if the operation is possible: black is enabled, dark gray is not enabled. The operation takes place only after operating OK.	1. Trigger (Input-Output) 2. Trigger enable 3. Trigger name
1 out n operation 		Field to operate a selection ("switch"). The color of the background and the color of the text indicates if the operation is possible: black text on white is enabled, dark gray text or gray background is not enabled. On the operation window, the operation selection is marked with a blue color. The operation takes place only after operating OK.	1. Selection 1 2. Selection 1 enable 3. Selection 1 name : : ... Selection n ... Selection n enable
Analogue operation 		Field to operate an analogue value. The actual value is shown. The color of the background indicates if the operation is possible: white is enabled, dark gray is not enabled. On the operation window, the operated value is shown. The operation takes place only after operating OK.	1. Upper limit 2. Input value 3. Lower limit 4. Operation enable 5. Upper limit name 6. Value name 7. Lower limit name 8. Actual value

Analogue operation 		Field to operate an analogue value. The actual value is shown. The color of the background indicates if the operation is possible: white is enabled; dark gray is not enabled. On the operation window, the operated value is shown. The operation takes place only after operating OK.	1. Input value 2. Value name
Binary setting 		Field to operate an binary value. The actual value is shown. The color of the background indicates if the operation is possible: white is enabled; dark gray is not enabled. On the operation window, the operated value is shown. The operation takes place only after operating OK.	1. Setting 2. Setting active text 3. Setting not active text

5.6. FACEPLATES

For every motor, drive, valve, binary alarm, measurement and controller the detailed status can be viewed with a faceplate. Two motor faceplates can be displayed:

1. Faceplate “small” (small window with the possibility making a selection out of several displays)
2. Faceplate “loop” (large window which contains all the displays)

With a click on the motor symbol with the left trackpad button, one of the faceplates “small” or “loop” will be displayed, (figure 5-12).

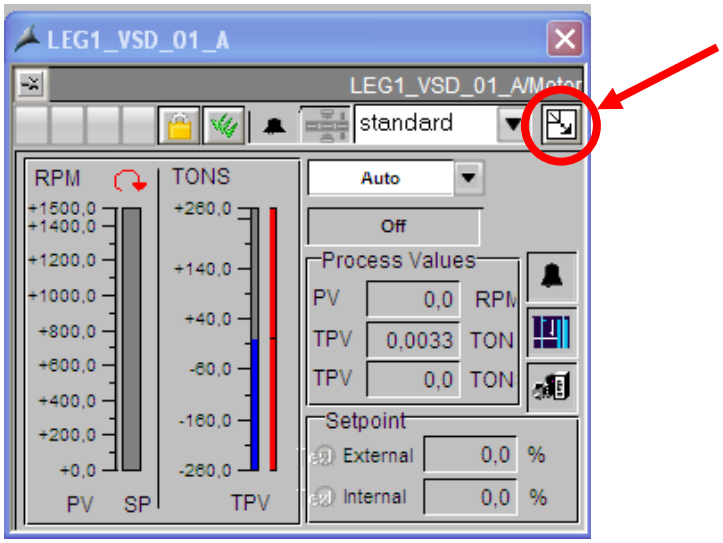


Figure 5-12: Faceplate selection

5.6.1. Motor faceplate “small”

Press left trackpad button to activate the faceplate. This faceplate shows the actual motor current and the actual motor speed. In the right upper corner a push button is displayed to activate the motor faceplate “loop” (figure 5-12).

5.6.2. Motor faceplate “loop”

Press button in right upper corner of motor faceplate “small” to activate the faceplate “loop”.

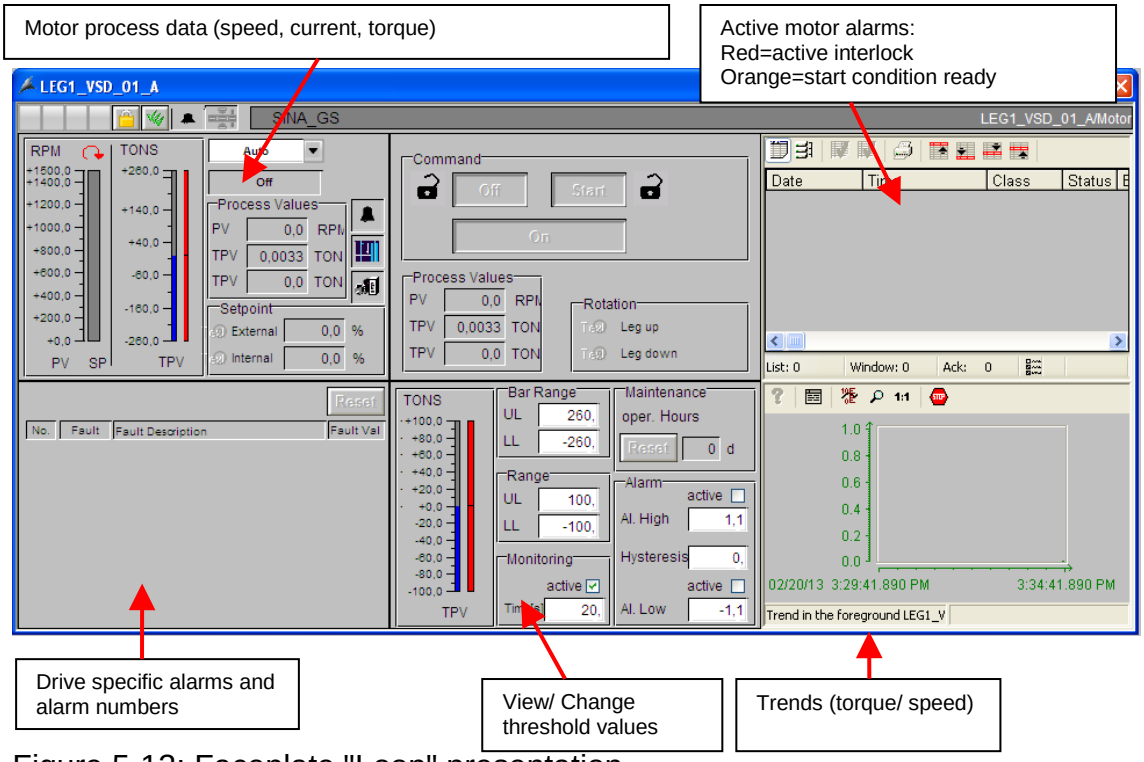


Figure 5-13: Faceplate "Loop" presentation

This faceplate shows more actual information of the motor:

- Active alarms of the motor
- Actual motor speed
- Torque (trend)
- Change alarm set points (requires super user authority)
- Alarm limits (operator II level required to change)
- Alarm fault numbers (the cause of the alarm and remedy can be found in the SINAMICS S List Manual, to be found in appendix D-6) and in PDF, to be found in the CD.)

Face plates close with the ESC key on the keyboard.

5.7. LOGIN AND AUTHORIZATION

Functionality on the OS is protected under authorization. The authorizations are related to the user who's logged in.

Login:

To determine the authorization level, it is necessary to login as a specific user. During start up of the OS (HMI software), system login screen appears. When the system is running, the user can be changed by calling the system login screen and select another user. This login window can be called up by two ways:

- By clicking on the current user, see table 5-2
- By operating button 2, see table 5-3

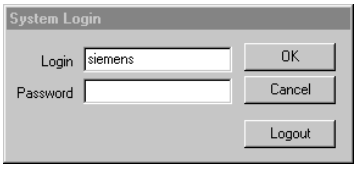


Figure 5-14: Operator login screen

The table below shows the permissions corresponding to the operator login. Login names and codes will be provided separately by GustoMSC.

Table 5-5: Authorization levels

	Authorization		*User group*		
No.	*Description*		*Super User SIEMENS / GustoMSC*	*Operator level II*	*Operator*
1	User administration	The User Administrator can be called up and changes may be made.	x		
3	System change	The user receives the right for status changes, e.g. deactivate runtime system.	x		
4	Monitoring/ Control	Enables the user to monitor and control, the process, e.g. normal jacking	x	x	x
5	Change alarm levels	In addition to authorization 4, this authorization also enables the user to control the process.	x	x	
9	Override Switch	This authorization enables the user to operate maintenance/process override switch.	x	x	
999	Siemens	Specific functionality only for engineering purposes.	x		

5.8. ENABLE OVERRIDE OVER INCOMING ALARM

Operator II level authority minimum is required for overriding an alarm. When a Process Override Switch (POS) is set, all warnings and alarms of that process are neglected. Check the Cause and Effect diagram (Appendix C-1.iii) for all the possible alarms to override.

Warning

In case the operator II level authority is changed to operator I level authority, all overrides on leg limit switches will be disabled.

The following example illustrates an alarm in override on leg extension limit switch.

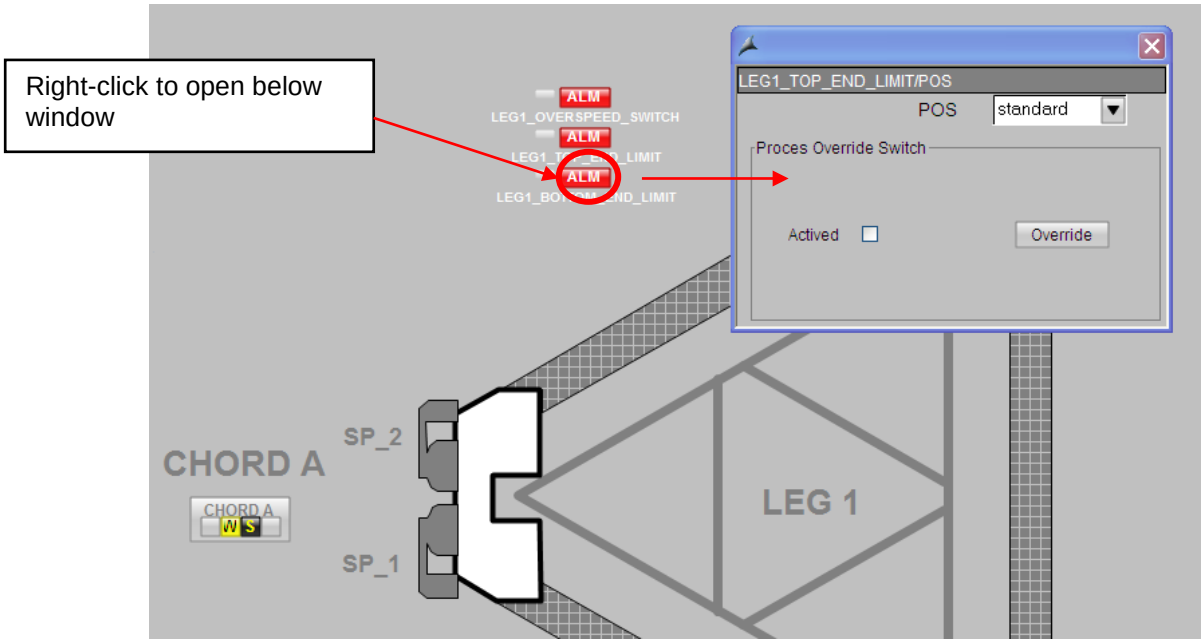


Figure 5-15: Enable override over incoming alarm

Use right trackpad click to select the process and enter the process override menu. Select ‘override’ and then ‘active=yes’ to enable the override. A blue POS icon appears at the process. The following applies to the POS utility:

- To disable the override, left click on the POS icon.
- To override the alarms of a complete jacking unit, see section 6-14.1.
- It is not possible to override alarms from the Emergency Shut Down circuit.
- It is not possible to override system alarms.

- For an overview of alarms which have an alarm override possibility, see cause & effect diagram in appendix C-1.iii.

5.9. ACKNOWLEDGE ALARMS AND MESSAGES

There are 2 ways to acknowledge the (alarm) messages.

1. Pressing the reset button on the CCD.
2. Click on the alarm acknowledgement icon in the WinCC button bar, single alarm acknowledgement.

Some alarms require a dedicated reset. Every incoming alarm needs a single reset (e.g. Rack Phase Difference alarm)

If an alarm is acknowledged, the system cannot be started up automatically. See the reset procedure in section 6.11.

The system does not stop on warnings. Acknowledging the warnings will move them to the acknowledged alarm list. Eventually when the cause of the warning disappeared, the warning will move to the outgoing alarm list. (See section 5.10)

Figure 5-16: Alarm acknowledgement icon WinCC button bar

Figure 5-2: Alarm reset button CCD

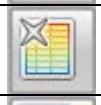
5.10. MESSAGE PAGES (ALARMS, SYSTEM MESSAGES, WARNINGS)

The HMI system has six message pages (alarm pages) configured. Each page has its specific functionality:

- Incoming alarm list: All messages that have not yet been acknowledged.
- Acknowledged alarm list: All messages that were acknowledged but have not gone out yet. (alarm still pending)
- Outgoing alarm list: All messages that have gone out (de-queued).
- Process alarms: All automation system messages.
- Operation list: All operator input messages.
- Journal list: All messages.

To open the different lists press the corresponding button on the button bar. (See table 5-6 below)

Table 5-6: Buttons to open event listings

33		Incoming alarm list	Incoming alarm list
34		Acknowledged alarm list	Acknowledged alarm list
35		Outgoing alarm list	Outgoing alarm list
36		Process alarms	Process alarms
37		Operation list	Operation list
38		Journal list	Journal list

Example of alarm list:

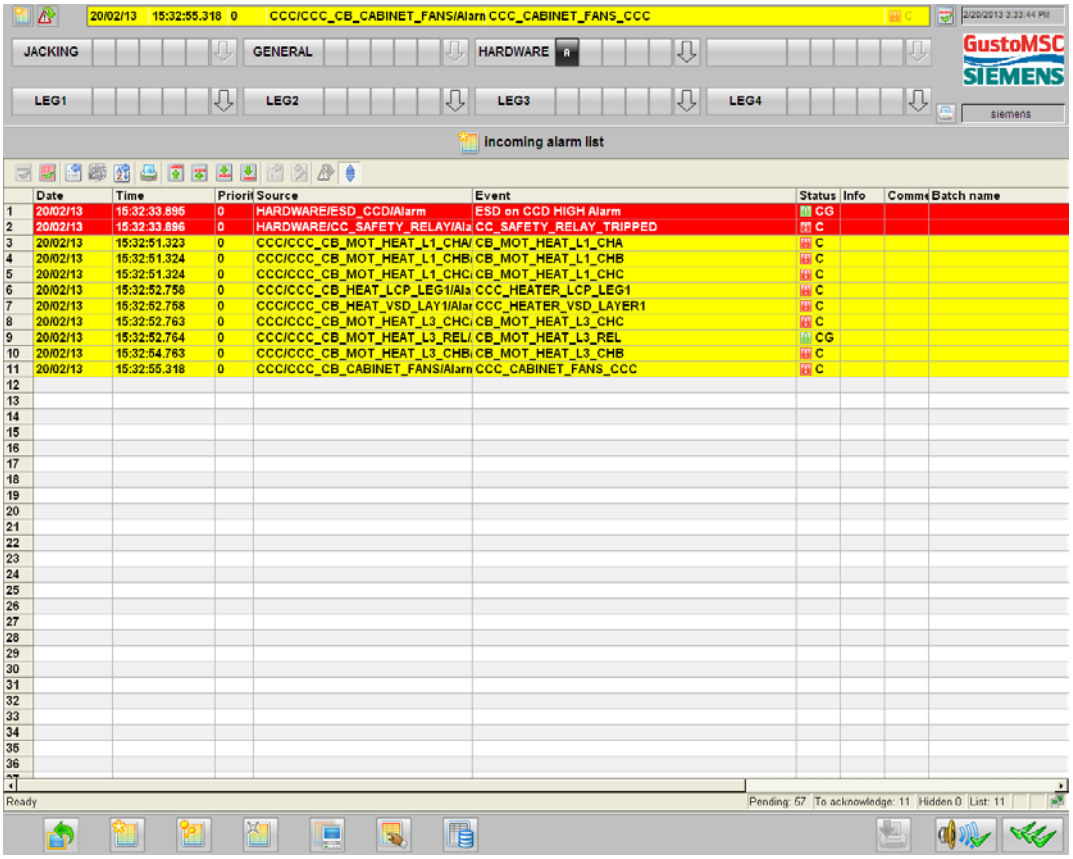


Figure 5-18: Example of an alarm list.

5.11. EVENT CLASSES

All system events will be logged. Every system event (alarm, message, operator login, change of value etc…) has its own code and color to identify the cause of the event. Also the symbols used in the HMI screen are equipped with the same philosophy. All system events are categorized in so called event classes. See the table 5-7 for an overview.

Figure 5-19: Loop-in-Alarm picture

The possible event classes explained:

Table 5-7: Event classes explained

Abbreviation of event class used on the HMI pictures			Event class / message text	Color	Meaning
Overview	Symbol	Faceplate			
A	H	AH	Alarm High	White/Red	Too High
W	H	WH	Warning High	Black/Yellow	High
W	L	WL	Warning low	Black/Yellow	Low
A	L	AL	Alarm Low	White/Red	Too Low
S	S	S	System Error	Yellow/Black	Hardware Failure
F	F	F	Fault	Yellow/Black	Hardware Failure

6. FUNCTIONAL DESCRIPTION CONTROL SYSTEM

6.1. LAYOUT CENTRAL CONTROL DESK (CCD)

Figure 6-1: Central Control Desk with inclinometer

The following functions and indications are provided on the CCD:

Key switches:
- Off / Standby / On
- Remote / Local

Push buttons:
- Normal Speed
- Set speed 1
- Set speed 2
- Alarm / Reset
- Lamp test
- Auto level
- Emergency stop button

Joysticks:
- Master joystick
- Individual leg control joysticks

Indication lights:
- On
- Local
- Motor heating on (lights up when motor heaters are activated)
- Desk heating on (lights up when heater CCD is on)

Buzzer:
- Buzzer

Inclinometer screen:
- Inclinometer (water level)
- Inclinometer values in degrees
- Leg loads in metric tons as derived from upper shock pads

The available functions are described in the section 6.3 up to section 6.15.

6.2. LAYOUT LOCAL CONTROL PANELS (LCP)

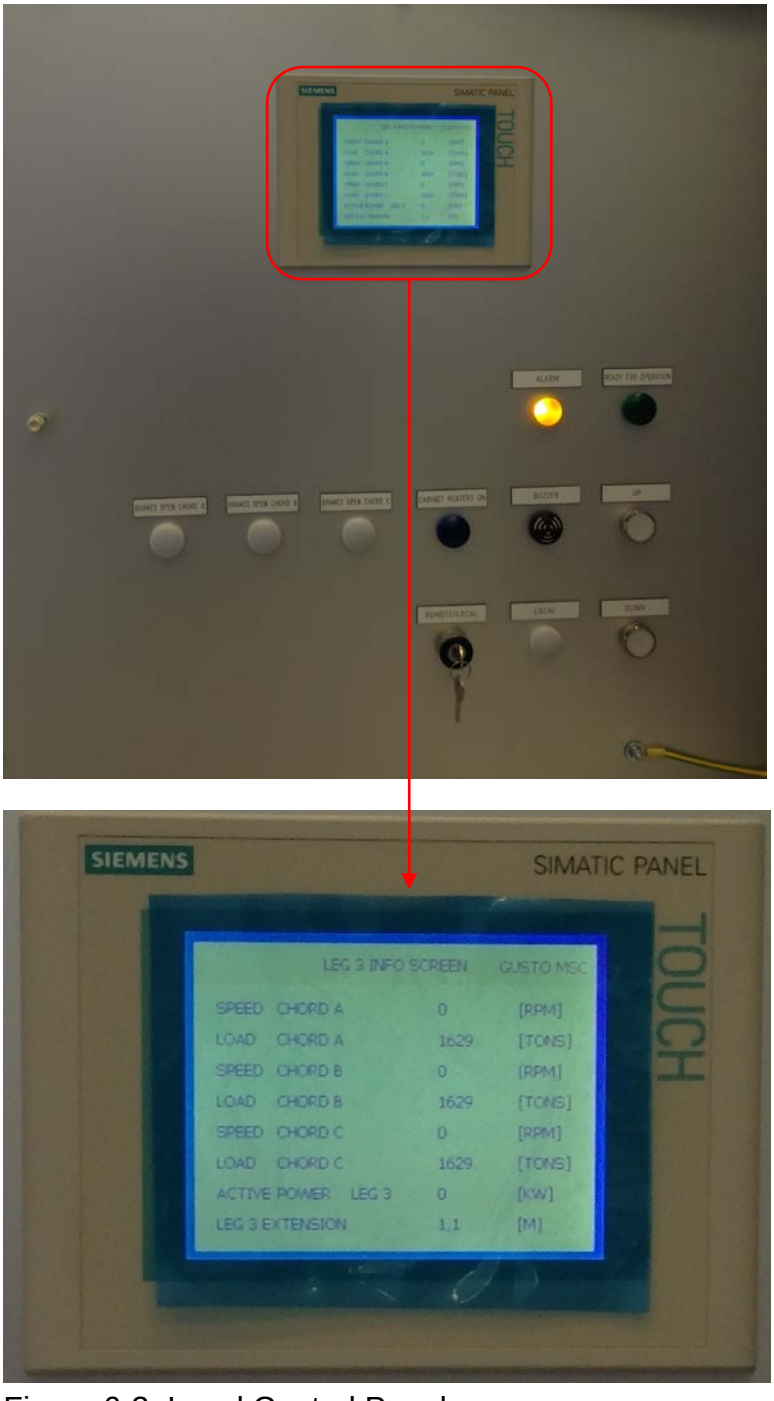


Figure 6-2: Local Control Panel

Tip

When running presented chord loads represent the motor loads without efficiency. When static and platform jacked shock pad loads are presented In case of leg handling no load information is presented. (See also section 5.3.2 for load type explanation).

The following functions and indications are provided on the LCP:

Key switch:
- Remote / Local

Push buttons:
- Leg up / down (Up, Down)
- Emergency stop button (outside on left side)

Indication lights:
- Ready for Operation
- Brakes released, per chord (on this platform individual release per chord is not possible)
- Local
- Cabinet heating on (lights up when LCP heater is activated)

Text screen:
- Leg extension in meters
- Power per leg
- Speed in rpm (note: on this platform all chords of a leg have equal speed)
- Load in metric tons per chord
  - The LCP displays the chord loads calculated from the motor loads without efficiency. When the motors are not running no chord load is indicated on the LCP.

The available functions are described in the following sections.

6.3. OFF / STANDBY / ON

The key switch OFF / STANDBY / ON is used to enable the jacking system.

With the key switch in position:

- OFF:
  - The Main Contactors are switched off, and so all motor brakes are engaged.
  - The PLC system and the HMI system remain powered on 230V supply (generator and UPS).
  - System keeps on displaying leg load (as derived from shock pads, when jacked)
  - Cabinets incl. drives are powered by 400V auxiliary supply.
- STANDBY:
  - In standby mode the main contactors will switch on energizing the rectifiers. In this stage the Jacking System is not active.
  - Joystick and buttons on the CCD are disabled.
  - The PLC system and HMI system are powered by 230V supply (generator and UPS)
  - Cabinets incl. drives are powered by 400V auxiliary supply.
- ON:
  - In this mode the rectifiers will switch on. This causes the DC-link to load which can be seen on the main screen on the HMI system.
  - Once loaded completely (approx 600V) the system is ready for operation.
  - It takes two seconds maximum to completely load the DC link. The ‘ON’ lamp next to the key switch will light on indicating the jacking system is active.

Figure 6-3: OFF / STANDBY / ON key switch

Note: full system shutdown is not standard condition. For long-term controlled shutdown and restart procedure, see section 6.14.5.

6.4. LOCAL / REMOTE

Remote means control from the CCD; local means control from the LCP.

Figure 6-4: Controls for local / remote on CCD

Figure 6-5: Controls for local / remote on LCP

Local control is for individual leg operating functions (lifting / lowering) and for maintenance purposes.

Local control can be obtained by following the next steps:

- The operator at the CCD turns the key switch (figure 6-4) from remote to local.
  - This causes the lamps on all LCP's and the CCD to flash. The operator at the CCD is still authorized.
- Turn the key switch on a LCP (figure 6-5) from remote to local to take over control.
  - The lamp 'local' at that LCP and CCD now lights up continuously, meaning the operator located at the LCP is in control.
  - The joysticks on the CCD are disabled.
  - The lamp 'local' at the CCD is on.
  - Operator at CCD can (still) adjust the jacking speed.
  - Local control can be selected on multiple LCP's simultaneously.
  - When the lamp ready for operation is on, the leg can be operated.

Remote control can be obtained by following the next steps:

- The operator at the LCP turns the key switch from local to remote.
  - This causes the lamps on that LCP to flash. The operator at the LCP is still authorized.
  - When all LCP’s are switched to remote, the lamps on all LCP’s and the CCD are flashing.
- Now the operator at the CCD must turn the key switch from local to remote to take back control.
  - The lamp local at the LCP`s and CCD is off.
  - The controls at (all) the LCP’s are disabled.
  - Joysticks at the CCD are enabled.

Warning

For safety reasons the key switches are edge triggered. This means that the position of the switches does not necessarily represent the authorization status of the system.

The ‘local’ lamp ‘on’ indicates that local control has been granted.

6.5. JOYSTICKS

Joystick leg 1…4

These joysticks are used for lowering / lifting one of the legs. The joysticks are of the spring return type (when not deflected the joysticks will return to the neutral position). To lower or lift a leg, the joystick needs to be pushed constantly.

Master joystick

This joystick is used for lowering / jacking the platform; and moving the legs with all legs simultaneously. The joystick is not of a spring return type (when released the joystick will stay put). The auto-level function can be used in combination with the master joystick.

Note: Joystick commands from zero to running are only detected when the motors are stopped.

6.6. OPERATING MODE

The Normal operating mode can be selected by the corresponding button on the CCD. The jacking system will monitor the maximum speed and motor torque. An alarm is generated if these values are exceeded. The speed of the motors is adjustable at all times (within the programmed limits) using the HMI system (WinCC). (See the instructions in section 6.8.)

6.6.1. Normal mode

When the jacking system is switched on, ‘Normal mode’ is selected by default. Normal mode will be used during normal operation of the jacking system; leg lowering, platform lifting, platform lowering, leg retracting, leg lifting. Normal mode can used in combination with the ‘Auto level’ function, see section 6.7.

Following system settings are applicable during operation in ‘Normal mode’:

Maximum speed setting:	0.8 m/min
Maximum leg load:	1782 mt
Maximum pinion load:	153 mt

6.6.2. Re-torque of pinions

In case re-torque of pinions is required, switch on the jacking system and set the speed set point to the minimum setting (0.2 m/min). Lift the platform over a short distance by operating the joysticks. The control system will set the torque on all pinions to the same value.

Switch the jacking system off.

6.7. AUTO LEVEL

While platform lifting or lowering, the auto level function is available by enabling this function at the CCD (for pushbutton see section 6.1). Auto level will only be active when using the master joystick.

Operating the master joystick down will lift the platform. Operating the master joystick up will lower the platform.

The auto level system will reduce individual leg speeds so that the platform stays leveled. If the auto level function cannot keep the platform leveled, an alarm is generated at an inclination of max. 0.3 degrees and the system is stopped.

To disable auto level, press the Auto level button once more.

Warning

When not in auto level mode, inclination of the platform will only generate a warning and alarm message and the system continues running.

Warning and alarm messages with respect to inclination are only generated when the platform is on its legs (at least 100 mt leg load). While the platform is floating inclination warnings and alarms will be suppressed.

Warning

- The Autolevel feature does NOT control leg loads, only platform inclination angles. Leg load warning and alarms remain active, but maintaining a proper leg load (distribution) is operators' responsibility.
- The Autolevel feature is NOT suitable to adapt to or follow a penetrating leg or leg punch-through.
- The Autolevel feature may adapt to slowly changing environmental conditions (such as prevailing current/wind load causing the platform to incline a bit), but when these conditions change rapidly (dead wind) the autolevel feature may not be able to react timely, causing platform inclination in opposite direction.

Tip

When the platform is preloaded and leveled, jacking with master joystick *without* Autolevel mode is normally accurate enough, over long jacking strokes.

6.8. CHANGING SPEED SETPOINT

6.8.1. General

To change the speed setpoint:

- Open the ‘General’ or ‘Jacking’ screen on the CCD see section 5.3.2 and 5.3.3.
- Click on the speed set point input field (see below figure) to change the value and press enter to confirm.

It is not possible to enter values higher than the maximum speed setpoints.

Figure 6-6: Setting speed setpoint

6.8.2. Set speed button

Depending on the speed setpoint set on the General or Jacking screen, the set speed buttons (see section 6.1) can be used to set a custom speed setpoint, different from the “fixed” maximum setpoint for the normal mode.

To set a custom set speed:

- Open the ‘Jacking’ screen on the CCD see section 5.3.3.
- Click on the set speed input field (see below figure) to change the value and press enter to confirm

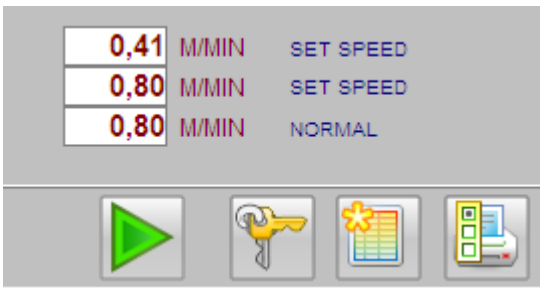


Figure 6-7: Set speed input field

It is not possible to enter values higher than the maximum speed setpoint.

6.9. BRAKE FUNCTIONALITY

Each jacking unit is equipped with a failsafe brake. The brakes are spring applied and electromagnetic released. The status of the brake is monitored with a Brake Control Unit (BCU) unit. The BCU also monitors proper functionality of the brakes. In case the brakes need maintenance, this will be indicated on the HMI screens, see section 5.3.

If required the brakes can be manually disengaged. See appendix D-2 for the manual of the brakes. The control of the brakes is performed by the control system of the jacking system.

The following sequence is used to disengage the brakes in normal operations:

1. The VSD's energize the E-motors and the speed set point is set to 0 rpm
2. The brakes are energized (disengaged)
3. When all the brakes are disengaged, the speed of the E-motors is increased to the required speed. In case not all the brakes of the energized are disengaged within 2 seconds, the brakes are engaged again, the E-motors de-energized and an alarm is generated.

The following sequence is used to engage the brakes:

1. When the joystick is released the E-motors ramp down to 0 rpm
2. When the E-motors have a speed of 0 rpm, the brakes are engaged.

See section 6.10 for a description of the brake functionality in case of an emergency situation (system fault or activation of an emergency stop).

6.10. STOPPING MODES

The way the jacking system stops depends on the kind of alarm. Which alarm will cause which stopping strategy can be found in the cause and effect diagram, see appendix C-1-iii.

PLC fast stop

This stop is initiated by the software in the PLC (e.g. leg position). The motors ramp down, the brakes will engage and the circuit breakers will open after 2 seconds. The jacking system has to be switched off and on (using the key switch) to reload the DC link voltage. Pressing the reset button will set system back to ready for operation.

Hardwired fast stop

This stop is initiated by the ESD circuit. The motors ramp down fast, the brakes will engage and the main circuit breakers will open after 2 seconds. The jacking system has to be switched off and on (using the key switch) to reload the DC link voltage. Then after a reset the system becomes ready for operation. The emergency stop circuit (the hardwired stop circuit) provides a failsafe system stop, independent from the software.

Uncontrolled stop

This stop is initiated by a critical drive failure. In this situation the motors coast down, the brakes will close and the main circuit breakers will open immediately. A reset is necessary to continue, provided that the failure is no longer present. For the reset procedure, see section 6.11.

Normal stop

A normal stop is initiated by a normal stop condition. In this situation the motors ramp down normally till they stop. Then the brakes will engage. The system can be restarted upon command.

6.11. ALARM HANDLING AND RESET PROCEDURE

6.11.1. Finding alarms

- Follow the ‘loop in alarm’ buttons on the HMI screen, see Table 5-2)
- If the motors won’t start, a red rectangle over the motor[s] appears. Open the faceplate showing the interlocks and start conditions to find out the jacking system won’t start.
- Open the hardware screen (see section 5.3.6) to check if any alarms or emergency will interlock the jacking system.
- Check for active alarms by opening the incoming alarm list (section 5.10)

6.11.2. Reset procedure:

- Solve the root cause of the alarm
- Switch off the jacking system using the key switch (see section 6.3)
- Wait 5 seconds
- Switch on the jacking system using the same key switch
- Press reset button several times until the messages disappear or the number of messages does not change.
- If the alarm is a system alarm (black and yellow message), the alarm is due to defective equipment. This means that the repair is needed. Check the component manuals for details, see appendix D.
- Other alarms can be temporarily overruled. How to, find the procedure in section 5.8
- Repeat the start up procedure in section 7.2.

Tip

In case a drive alarm cannot be reset with the procedure as described above, the following procedure applies:

- Determine the location of the drive with an alarm by following the ‘finding alarms procedure’ as described above.
- Determine the layer in which the drive is located.
- Reset drive electronics by switching off circuit breaker =00.G-Q1 located in the VSD cabinet for the applicable layer.
- Switch on circuit breaker =00.G-Q1 and continue operation again.

6.12. LEG EXTENSION AND LEG END DETECTION

6.12.1. General

The leg extension is calculated by the control system and is based on the number of E-motor revolutions. The E-motor revolutions are monitored by the encoder.

The leg end detection (top and bottom) is performed in 2 ways:

1. Based on the calculated leg extension (warning and alarm)
2. Based on the leg end detection switches (alarm)

In case the leg end is the detected, an alarm is generated and the system is stopped (see cause and effect diagram appendix C-1-iii). See section 5.8 for overriding the leg extension alarm, for example to elevate the spudcans above waterline up to inspection level.

6.12.2. Resetting the leg extension

The leg extension can be reset to 0 when the leg is fully retracted and the 'leg up end detection switch' is activated. To reset the leg extension, select the hardware screen, see section 5.3.6, and click on the reset button in the leg extension area. Select reset and click 'OK'. When the leg extension is reset, the Rack Phase Difference is also reset.

6.13. RACK PHASE DIFFERENCE

The jacking system is equipped with a RPD monitoring system. The RPD display shows relative differences in displacement of the 3 chords for each leg. Displacement of each chord is calculated from the encoders of the motors.

If the difference between the highest and lowest chord exceeds the warning and alarm values as specified in section 0 a warning or alarm is generated, see appendi C-1-iii. In case of a rack phase difference alarm, the system is stopped automatically.

See section 5.8 for overriding the rack phase difference alarm.

Warning

- In case of a ‘rack phase difference’ alarm, the operator should always check the leg structure for damage and find the cause of the alarm.
- After overriding the alarm, the jacking system should only be used to solve the rack phase difference and not continue jacking.

The rack phase difference can be reset to 0 when the leg extension is reset, see section 6.12.2

6.14. SPECIAL OPERATIONS

6.14.1. Leg pull override mode

When, during a leg pulling operation, the leg load exceeds the leg load alarm levels for normal operation, the jacking system will trip as soon as the leg is operated. In such a situation it is possible to increase the negative leg load alarm levels to bring the platform back to a safe situation. The following applies to the leg pull override mode:

- Leg pull override mode is only activated for leg lowering motions, alarm levels will not be increased during leg lifting motions.
- In leg pull override mode only the negative leg load alarm levels are increased. In leg pull override mode the following leg load alarm levels apply:
  - Constant speed: Positive leg load alarm: 1782 ton; Negative leg load alarm: 2857 ton
  - Ramp up / down: Positive leg load alarm: 1863 ton; Negative leg load alarm: 2986 ton

The procedure for leg pull override is as follows:

- Activate the leg pull override mode via the push button on the HMI (Hardware screen, see section 5.3.6)
- Press and hold the Normal mode push button on the CCD, see section 6.1.
- Operate the joystick (master joystick or individual leg joystick) in leg lowering direction

De-activate the Leg pull override mode as soon as the leg loads are back to normal levels below the alarm levels

6.14.2. Operation with failed jacking unit

In case a jacking unit is not functioning properly and immediate repair is not possible, operation with a reduced number of jacking units is possible.

This applies for mechanical problems on the jacking unit and drive; and for control problems of the motor (motor, encoder, brake, brake control, VSD).

Warning

In case of missing encoder signal while running; an alarm will be generated and the system will be stopped. In case of generation of this alarm, the encoder cable should be checked or a POS should be set on the jacking unit.

Overrule alarms coming from jacking units:

WARNING

- Do not overrule jacking units before manually lifting the motor brakes. Once overruled, the system won't react on the feedback of the brakes. If this happens, theoretically the brakes can be closed while the jacking system is running. This will damage the brakes and can cause fire.
- Malfunctions in the hardware prevent the system from operation (such as short circuit in the encoder cable). To bypass these malfunctions, defective devises are to be cleared by the electrical engineer (e.g. in cases of short circuit disconnect encoder cable).
- To avoid unbalance in the jacking frame, the opposite motor is also overruled and should be treated as defective jacking unit, including manual lifting the brake and disconnecting the power cables.

- Log in as operator with level II authorization, see Section 5.7
- Release the brakes mechanically, see appendix D-2 for the brake manual; or in case of a defective gearbox / pinion remove the complete jacking unit.
- Disconnect the power cables of the overruled unit.
- On the ‘Jacking screen’ (see section 5.3.3), left click on the brake area will overrule all alarms coming from this particular motor break combination.

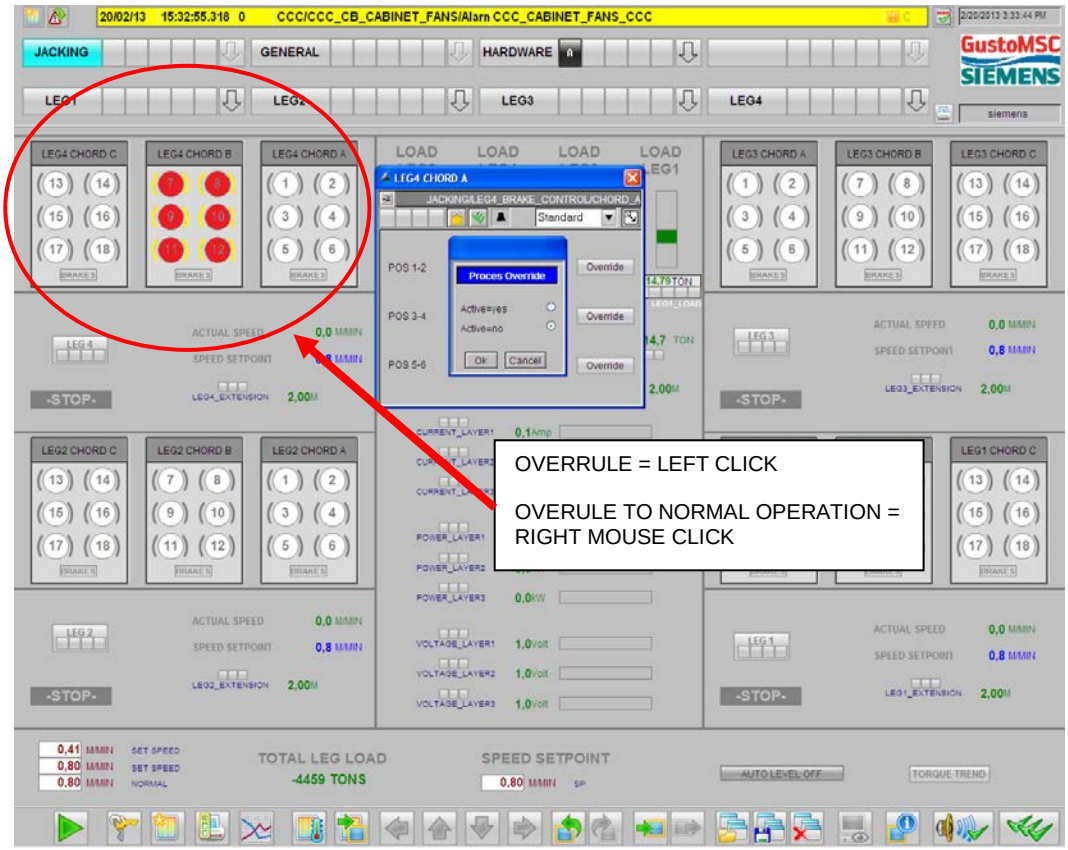


Figure 6-8: motor brakes in alarm

- When the POS (Position Override Switch) becomes visible over the motor brake combination, it is active. See figure 6-9.

Figure 6-9: Position Override Switch

- Only one motor brake combination per chord can be overruled.

Warning

Design allow for only two (2) opposite jacking units per leg to be out of order. Overriding more jacking units may result in overload of the jacking system and/or leg.

- Log out and log in again as normal operator. (See section 5.7)
- Reset the alarm coming from the brake. (See section 5.9)
- The motor brake is disabled now and start up is possible.

Warning

When a jacking unit is overruled, the maximum allowable load on the other jacking units is increased from 90 mt to 101 mt.

From overrule mode back to normal operation:

- Set the brake to its original setting (brake engaged)
- Log in as operator 2 see section 5.7.
- On the ‘jacking screen’ (see section 5.3.3), right click on this brake.
- The POS icon will disappear, indicating that the motor/ brake combination will be active again.
- Log out and log in again as normal operator (see section 5.7)

6.14.3. Operation with failed shock pad load measurement

In case one or more shock pad sensors are not functioning properly and immediate repair is not possible, operation with a reduced number of shock pad sensors is possible.

In case of a bad signal from the shock pad the following actions are taken by the control system:

- A warning message is generated indicating which shock pad gives the bad signal. The system is not automatically stopped in case of a bad signal from a shock pad.
- The value coming from the shock pad is changed to the maximum shock pad value of 664 t.

The operator has the possibility to override the shock pad sensor:

- Login as user with operator II authorization, see section 5.7.
- On the Leg screen, left click on the shock pad area to put a POS on the shock pad.

With the POS the control system derives leg load from the remaining sensors only.

Tip

Design allow for five (5) shock pads per leg to have a POS on load measurement. However this will affect the accuracy of the calculated leg load.

Log out and log in again as normal operator. (See section 5.7)

From overrule mode back to normal operation:

Login as user with operator II authorization, see section 5.7.

- On the Leg screen right click on this shock pad.
- The POS icon will disappear, indicating that the shock pad signal will be active again.
- Log out and log in again as normal operator (see section 5.7)

6.14.4. Operation without HMI

Whenever the HMI screens are not functioning, the system can be controlled with all the push buttons and joysticks. In this case it is not possible to use the functions that are normally controlled on the HMI screens, such as a change of speed set point.

The inclination display at the CCD shows inclination and leg loads as derived from the upper shock pads.

The following data can be found on the displays at the local control panels:
- Speed of each chord
- Load on each chord
- Extension of the leg

6.14.5. Long term system shutdown and recovery

In normal situation when jacking operation is not required, the jacking system is ‘OFF’ by means of the key selector switch. As described in section 6.3, the system uses 230V and 400V power supply, of which the 230V must be uninterrupted (UPS)

In case long-term full vessel black-out is expected, the system may be prepared as follows. Note that leg load monitoring will be switch-off also.

For long term shut down follow the following procedure:
- Set the system in OFF mode on the central control console.
- Logon at Operator 2 level on the HMI to logoff the WinCC system (by left click  on the button bar)
  Click on the button “Shut down PC” (In the left below corner of the Hardware Screen, see figure 6-10) to shut down PC.

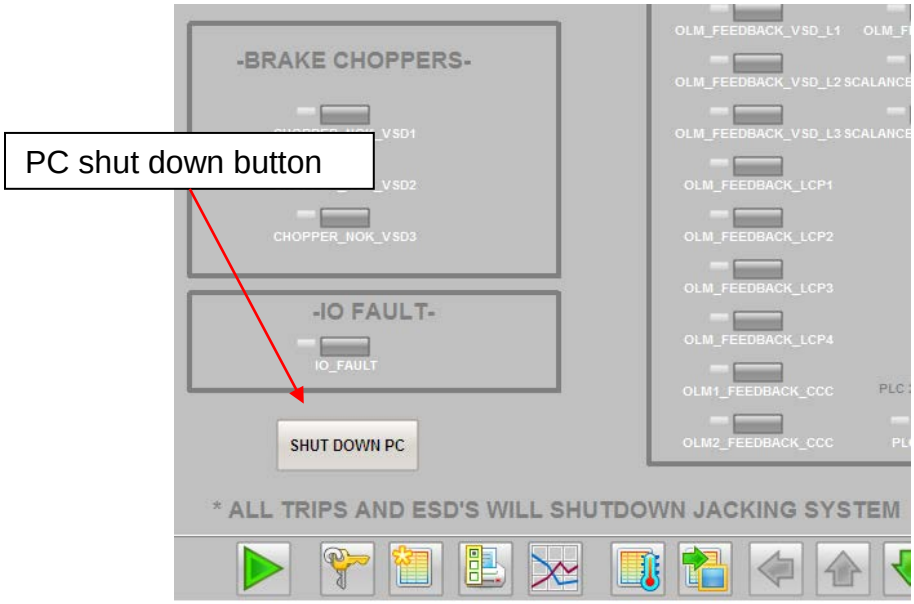


Figure 6-10: PC Shut down button

Warning

Exit runtime will disable the HMI functionality.

- The HMI will be stopped. When all windows are closed, the box-PC which is located in the control desk can be switched off.

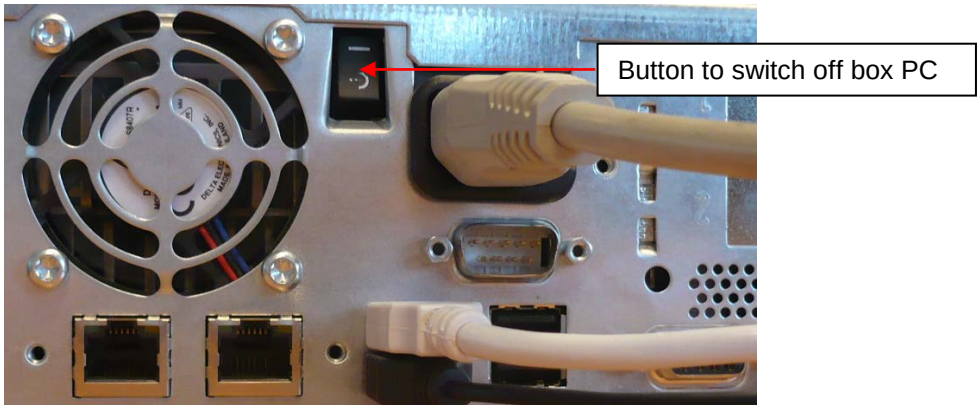


Figure 6-11: On off switch located at the back of the box-pc.

- Make sure 230V UPS is powered all the time, because batteries can only hold for 1 month maximum
- Shut down all other power supplies and systems.

To start up again switch on all powers and systems and switch on box PC.

In case of long-term shutdown (typically >1 year), reference is made to the various equipment manuals for pre-recovery inspections and measures, and to Class requirements and recommendations. Specifically, in case of recovery after shutdown of 2 years or more, refer to the reforming instructions for the DC link capacitors.

6.15. EMERGENCY OPERATIONS

6.15.1. Emergency stop

Activation

Press one of the available emergency stops to stop the jacking process immediately.

This is a hard wired stop, working independently from the software. The brakes will engage immediately. The brakes will engage, controlled by hardware, no matter what the motor speed might be.

Meanwhile the drives will try to stop the motors as fast as possible, reversing the direction of the torque.

After two seconds the ESD circuit opens the main circuit breakers, cutting off the power. This will close all the brakes (fail safe) if for some reason this was not the case already. Also all drives are de-energized now.

The emergency stop has no effect on the PLC and HMI (beside notification of the emergency stop itself). On the ‘hardware screen’, the active emergency stop is now red.

Warning

In case of an ESD activation a brake low voltage can occur resulting in a warning. This is warning does –in such a case- not have any functional implication and can be reset without further investigation.

Reset

Make sure the reason for this emergency stop is no longer present. Turn and pull the emergency button to deactivate the ESD circuit and to enable the jacking system. Follow the reset procedure to restart the jacking system, see section 7.2.

The main difference of a normal stop in relation to an emergency stop is that during a normal stop the brakes will close when the motor speed is reduced to almost zero. Frequent use of the emergency stop will deteriorate the motor brakes.

6.15.2. Switch over PLC

Warning

PLC switchover only makes sense if the PLC itself is defective. Prior to change over, make sure all other system parts are working properly.

- Make sure jacking system is in position OFF
- Open the door of cabinet +1F02
- Check status of the second PLC by checking the status indicating LEDS of the PLC2 system

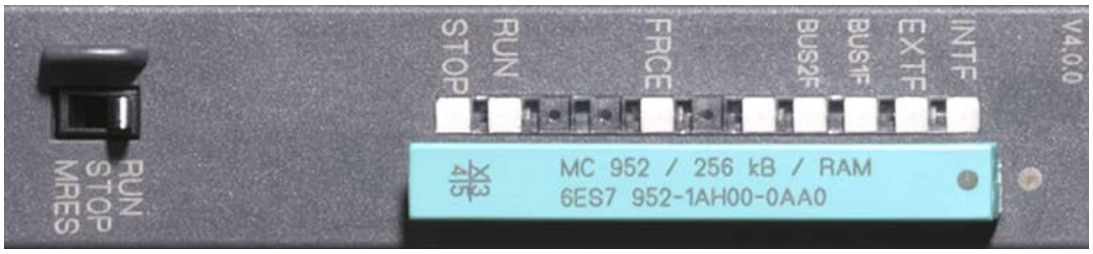


Figure 6-12: PLC indicating LED`s

- INTF Should be off
- EXTF RED is allowed (occurs when PLC1 is master)
- BUS1F RED is allowed (occurs when PLC1 is defective)
- BUS2F RED is allowed (occurs when PLC1 is master)
- FRCE No meaning
- RUN Should be green
- Stop Should be off

Warning

If RUN or STOP or INTF do not match these settings, PLC2 is not ready for switching over.

- Switch over to the other PLC using the key switch, see figure 6-13.

Figure 6-13: Key switch for PLC switch over

- After switching over, EXTF and BUS2F should be OFF for normal operation
- Follow the start up procedure as described in section 7.2
- The jacking system is ready for operation

Warning

There is no need to make adjustments or change settings. These are already stored in both PLC's except for overrides. Overrides will need to be re-set.

7. OPERATING SEQUENCE

See the Designer's manual for the operations of the MSC NG2500X Jack-Up Unit, for the overall operation of the unit. This manual describes the overall sequence for the installation of the platform on location. This manual only describes the checks and operation of the jacking system.

7.1. BEFORE START-UP

The following checks have to be completed for leg and jacking unit before start-up:

- Check all jack houses and make sure they are clean and tidy (no loose items).
- Verify that the legs are not obstructed and free to move
- Verify that the jacking units are undamaged
- Verify that the legs and racks are undamaged
- Check oil level of the gearboxes and fill up if required
- Grease the bearings of the jacking units; see section 8.2 for recommended grease interval.
- Grease the racks of the legs. Make sure the full contact surface between pinion and rack will always contain sufficient grease.
- Check if all ventilation openings of cabinets and brake resistors are unobstructed.
- Ensure sufficient power generators are available online. Monitor electrical load.

Warning

To avoid damage to the rack and pinions, the racks should be properly greased throughout the duration of the jacking operation.

After complete black out (including UPS) or in case of new PLC start up a number of alarms and warnings will occur (e.g. Drive warnings 0). These alarms and warnings can be reset without further investigation.

Before starting up the system the system needs to be energized:

- Check if the switches -S01-S03 in the cabinets +1F02 and +1F03 (Central Control Cabinet) are on.

- Check if the PLC located in cabinet +1F02 is on. (Circuit breakers 00.G-F7 or 00.G-F8)
- Switch on all the main switches located on the doors of the VSD cabinets.
- Follow the reset procedure in section 6.11
- Check and fix any remaining alarms on the HMI screen (see section 5.10)
- Perform a lamp test.
- Ensure all fans are running.

7.2. STARTING UP

- Turn the key switch ‘OFF / STANDBY / ON’ on the CCD to ‘ON’.
- Check the HMI screen if the DC links will pre-charge. If the DC links are fully pre-charged then the system is ready for operation.
- The bar graph shown in figure 7-1can be used to check if the DC links are fully charged.
- Use the joysticks to start the jacking process (section 6.5).
- If the drives won’t start, find more information in section 6.11.

Figure 7-1: Screenshot of the HMI system: Jacking Screen

7.3. LEG HANDLING

7.3.1. Leg lowering /lifting

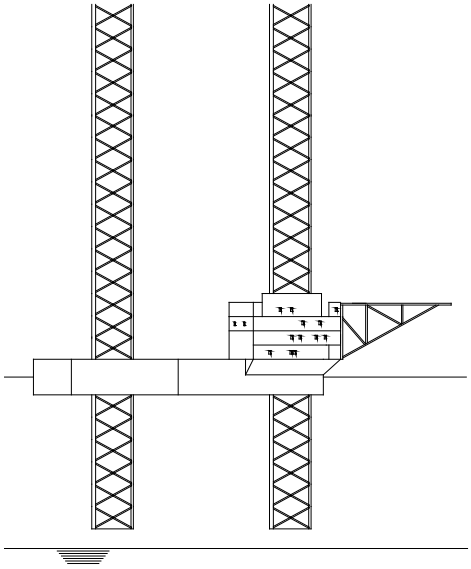


Figure 7-2: Platform in leg lowering / lifting stage

Lowering and lifting the legs can be controlled from the Central Control Desk (CCD) or from the local control panels (LCP) near each leg. The controls of the LCP are assigned to one leg only. (Meaning only one leg will move up and down when started from the LCP)

When leg handling is active, the shock pads cannot determine the loads.

Warning

When the brakes are engaged during leg handling, the actual load is not shown on the screens, since the lower shock pads do not have load measurement.

During leg handling, the maximum speed setting is 0.8 m/min with use of the normal speed button. If required, the operator can adjust the speed set point.

Control leg handling from the CCD:

- Set the jacking system to remote operation. See section 6.4.
- Use the main joystick to control all legs simultaneously or the leg joysticks to control one leg only.
- Use the normal speed button for the maximum speed setting 0.8 m/min.

Control leg handling from LCP:

- Set the jacking system to local operation (see section 6.4).
- On the LCP all chords are selected automatically.
- Use the ‘legs up’ and ‘legs down” buttons to control the leg movement.

During leg lowering the motors are running in regenerative braking mode (this means the energy of lowering will be dissipated by the braking resistors).

The system will generate an alarm and will stop if the position of a leg reaches the lower or upper limit. The motors will be stopped and the brakes applied.

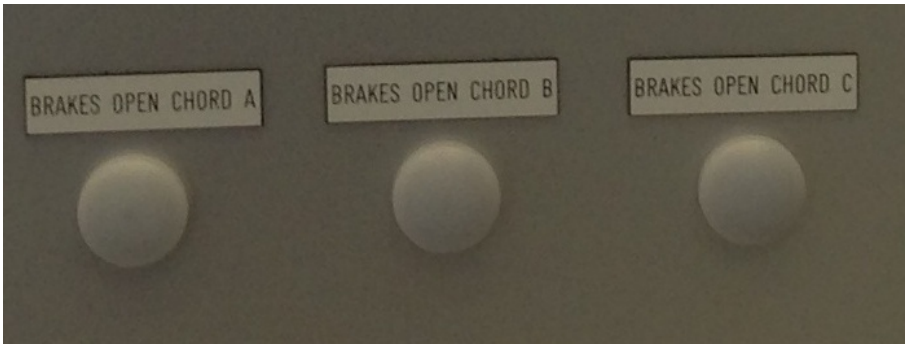


Figure 7-3: Brake feedback indicating lights

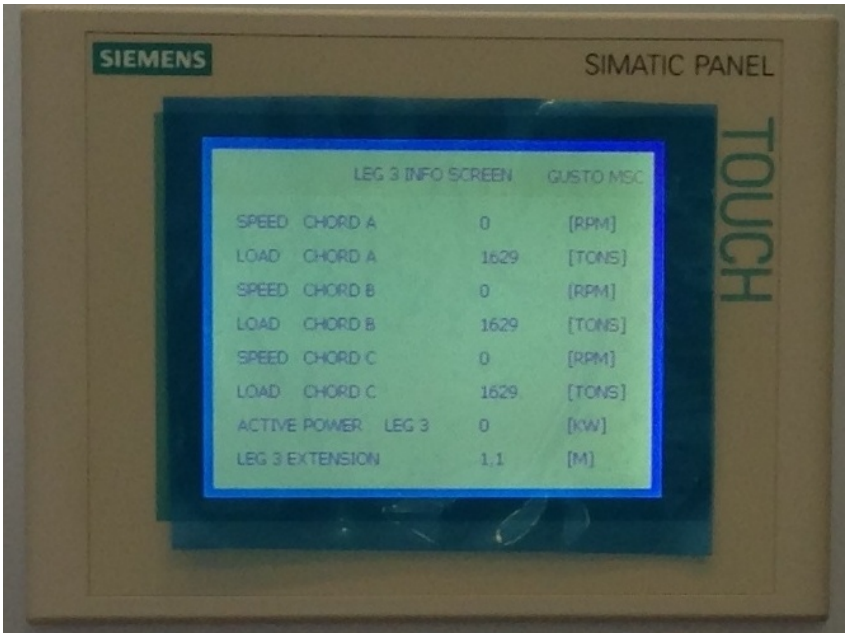


Figure 7-4: LCP text screen showing leg extension and chord load.

7.3.2. Leg extracting / pulling

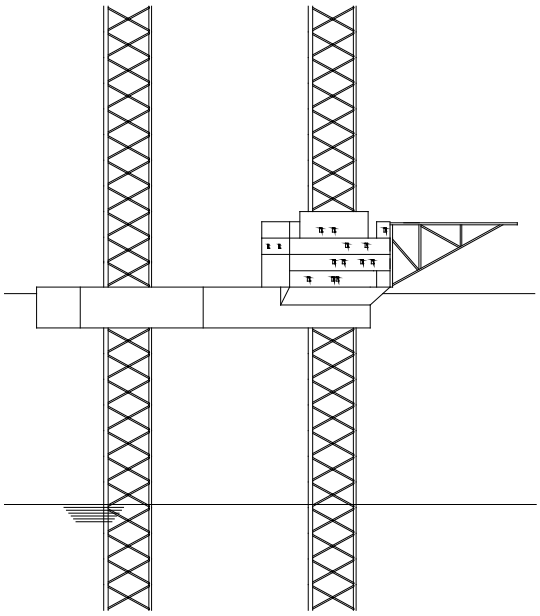


Figure 7-5 Platform in leg extracting mode

When the legs of the platform are penetrated in the seabed, the legs can be extracted using the leg joysticks on the CCD or the buttons on the LCP similar to leg lowering / leg lifting. Use normal mode to extract the legs. The maximum speed setting is 0.8 m/min. the operator can adjust the speed if necessary.

Leg extraction procedure:

- Do **not** enable the auto level function while extracting the legs.
- Set the jacking system to remote operation or if local operation is preferred choose local mode (See section 6.4).
- Set the jacking system to normal mode (See section 6.6)
- Use the leg joysticks on the CCD or the ‘leg up’ and ‘leg down’ buttons on the LCP to start extracting the legs.

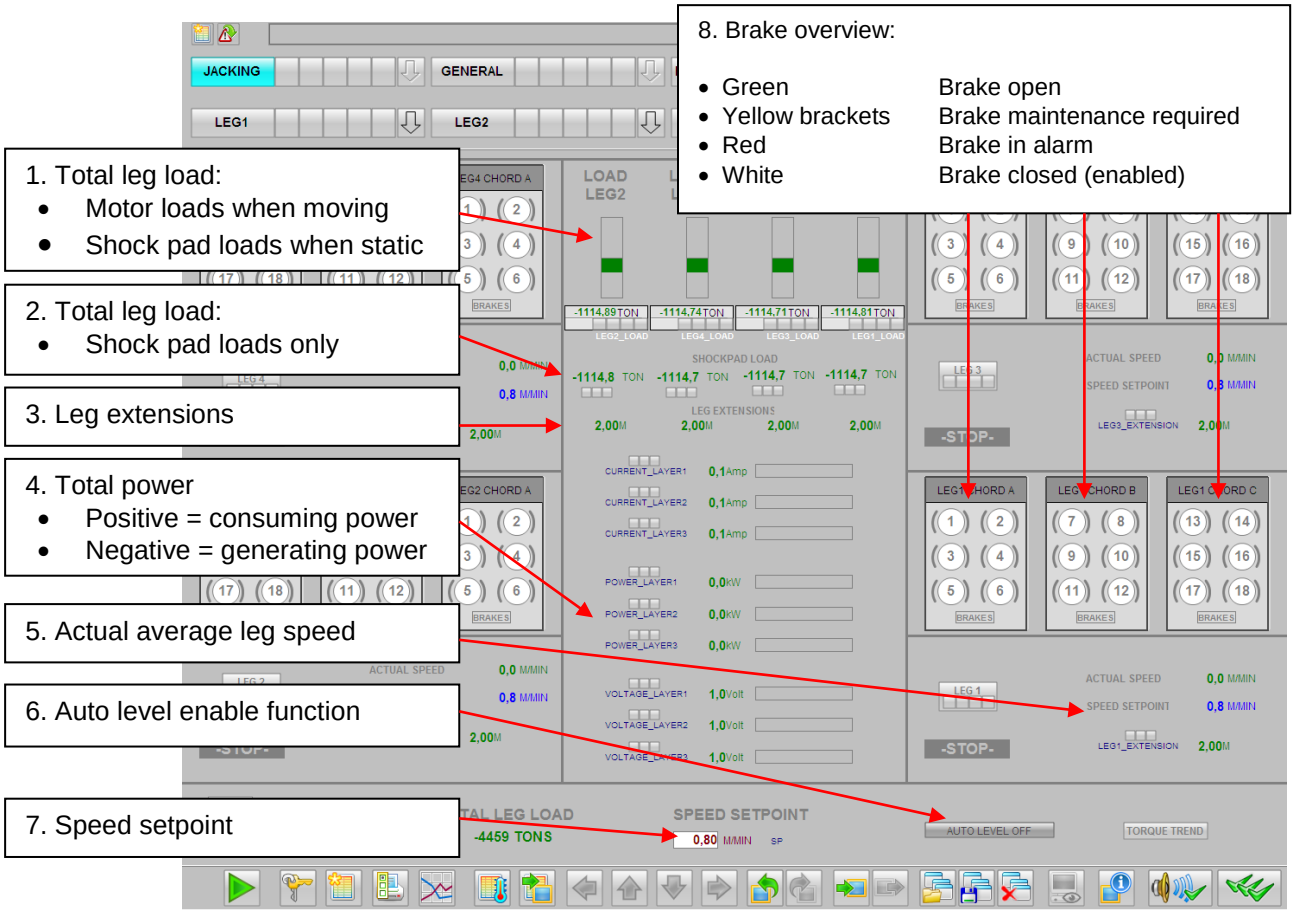


Figure 7-6: Important variables while extracting the legs

7.4. PLATFORM HANDLING

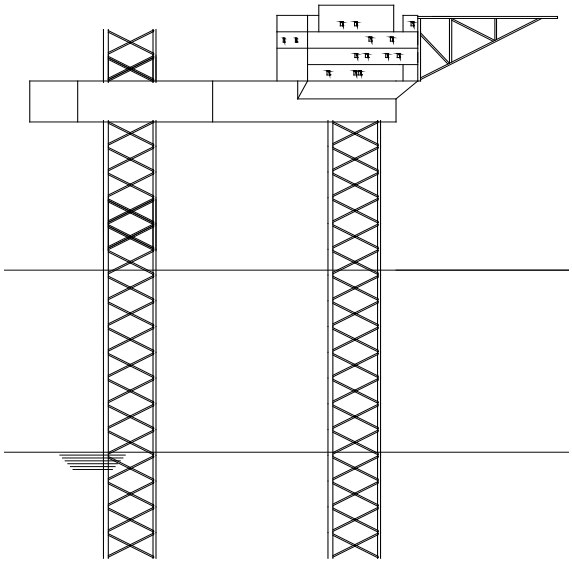


Figure 7-7: Platform in jacking / lowering mode

When platform handling is active, the loads on the main screens are determined from the actual motor data. When the platform is not operated, brakes are engaged. In this case the loads on the main screen are the total of all shock pads of a leg. On the leg screens the individual shock pads are always visible.

Pressing the master joystick down will lift the platform. Pressing the main joystick up will lower the platform.

Inclination data is available from the display in the CCD. The measurements from this device will be used by the software which takes care of the Auto leveling of the platform. This auto level mode is only active when the main joystick is used and the button ‘Autolevel’ is active (lamp ‘Autolevel’ flashing or on). See section 6.7. Autolevel mode can be switched off by pushing Autolevel button again.

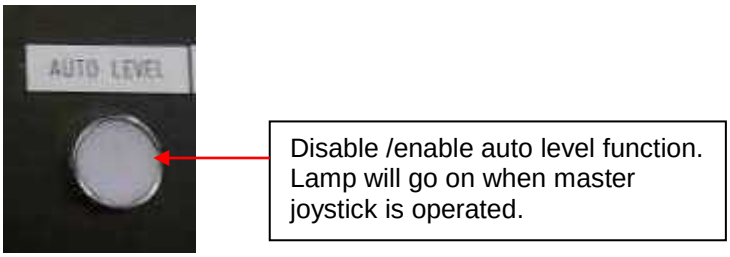
If one of the leg joysticks is used, automatic leveling will not be active and the lamp ‘automatic leveling’ on the CCD will stay flashing. The auto level function should be disabled manually before the platform hits the water.

Inclination data is also available from the jacking screen on the HMI system. See section 5.3.3.

While jacking or lowering, the operation can be stopped manually by moving the joystick to its neutral position. Actual values of the load and leg positions can be checked from the HMI screens.

During platform handling, the maximum speed setting is 0.8 m/min. If required, the operator can adjust the speed set point.

In the event of a joystick failure on the CCD the legs can be moved separately using the LCP. See section 6.4 how to do this.



Figures 7-8: Auto level on CCD for platform jacking /lowering.

Procedure:

- Optionally the Auto level function can be activated (See section 6.7).
- Open the General screen to monitor the platform lifting / lowering process.
- Use the master joystick, or the individual leg controllers on the CCD to move the platform up and down.
- During platform lowering, disable the Auto level function just before the platform hits the water.
- During the jacking operation, closely monitor the load. When close to the limit, first warning messages will be generated. On load values close to the maximum values decrease the speed setting.

When lowering the platform the braking energy will be dissipated by the braking resistors. This will heat up the resistors. The maximum energy which can be dissipated is 265 kW per resistor bank. If the resistors are overheated, e.g. due to a fan failure, an alarm will stop the Jacking system. When this happens, the system can be reset after the resistors cooled down (See reset procedure, section 6.11).

7.5. PRELOADING

The maximum load on the jacking system while running is the normal effective jacking load. Preloading of the legs is performed by retracting (=reducing load) other legs (‘passive preloading'). Preloading shall always be performed on diagonal legs.

Procedure:

1. Lift the vessel to the required airgap for preloading.
2. Retract two diagonal legs (e.g. leg 1 and 4).
3. Monitor the loads on the other two legs. These loads should never exceed the allowable average preload holding load (2754 mt/leg).
4. Monitor minimum load on the legs being retracted. To ensure platform stability, a minimum load of approx. 100 mt per leg is recommended.
5. Monitor the inclination. The inclination should never exceed 0.3 degrees.
6. To level the vessel, extend the retracted legs until all leg loads are below the maximum allowable effective jacking load (1582 mt/leg). Level the vessel.
7. Repeat step 1 up to 5 until the required preload is reached.
8. Maintain the preload for the required period of time. During this period, the loads and inclination should not change.
9. Repeat step 1 to 7 for the other two legs.

7.6. STOP OF JACKING OPERATIONS

Once the fixation system is engaged and the procedure is completed, turn the key switch to off (section 6.3) to shut down the jacking system. The voltage of the DC link will slowly drop to zero. For safety press the emergency stop at the CCD desk.

- Never switch off the PLC if not really necessary.
- It is not recommended to switch off the computer in the CCD.
- Switch on the heaters of the E-motors and the brakes.

8. MAINTENANCE MECHANICAL SYSTEM

8.1. JACKING UNIT

The jacking unit includes the gearbox, lantern piece, bearings and the pinion shaft parts.

The middle roller bearing of the lantern piece is lubricated by the oil of the gearbox and does not need any maintenance.

For the end roller bearing a separated grease pipe including a grease nipple is installed.

Before lowering and lifting the legs, 1 stroke of grease to be applied with a grease gun on all gearboxes (72 times). Type of grease: EP-2 or equivalent.

According instructions of the gearbox manufacturer: after 50 hours of operation, all bolts to be checked on torque force and oil level check by using the dipstick.

After 150 hours the lubricating oil to be changed out and check on particles.

The next oil change, every 3 years.

Warning

The rack must be greased at all times when the jacking system is operational.

Recommended type of grease: Texclad 2 or equivalent

8.2. SHOCKPADS

The shock pads require an annually visual check for cracks in the protective coating including the mastic sealer and proper fastening of the connection bolts.

When damaged spots or cracks are found the coating or the mastic sealer must be repaired as soon as possible. If by accident a large amount of oil or other hydrocarbons are spilled over the shock pads, clean them with oil absorbing cloth as soon as possible.

In case of overloading, inspect the shock pads as soon as possible for defects.

For the integrated Load Measuring System at the upper shock pads, no maintenance is required after the shop calibration. Each shock pad has a 2nd, redundant load measurement system built in. Perform a visual check for mechanical damage of enclosure, connections and cables.

8.3. JACKING FRAME

For the jacking frames only an annually visual check on paint damage is required, including the gearboxes and drive units.

Cable and screws for earthing terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

8.4. MAINTENANCE INTERVALS

Table 8-1 shows an overview of the required maintenance and the applicable intervals.

Table 8-1: Mechanical maintenance intervals

Component	Document	Interval	Action
Pinion/Rack	n.a.	Each lowering/lifting	Both greased throughout the jacking operation
Pinion end bearing		Each second lowering / lifting operation	Each nipple one stroke of grease
Gearbox		Every three years	Lubrication-oil to change out
Gearbox	n.a.	Every 50 running hours	Check oil level
Gearbox		Annually	Check tightening of fixation bolts
Shock pads	n.a.	Annually	Check for cracks and damage
Jacking frame	n.a.	Regularly	Check cable and earthing terminals
Jacking frame guides	n.a.	Annually	Check on wear and tightening of bolts.
General	n.a.	Annually	Overall inspection including painted surfaces

9. MAINTENANCE ELECTRICAL EQUIPMENT

9.1. PREVENTIVE MAINTENANCE

The purpose of preventive maintenance is to preserve the specified condition of the jacking system.

For specified serviceable components in the cabinets, maintenance instructions can be found in the corresponding equipment manuals. It is highly recommended to observe these instructions before first use of the Jacking System. Also the corrective maintenance procedures, if any, can be found in the documents.

Warning

Various components require a special setting by means of (dip-) switches or other means. Before a component is removed, this should be checked and the setting should be noted. Refer to the system schematics (see appendix C and the component documentation (see appendix D) for details.

This covers only fixed setting and not ‘dip-switch programming’. For components that need dip switch programming check the component data sheets. Typical components that need dip switch programming are the emergency stop relays (component no.: =07m K1, K2 and K3, see appendix D-4).

9.2. GENERAL GUIDELINES FOR MAINTENANCE

This Section describes the general guidelines for maintaining the jacking system.

9.2.1. Dust deposits

Dust deposits inside the devices and cabinets must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. All components in each cabinet must be cleaned using a brush and vacuum cleaner, and dry compressed air (max. 1 bar) for areas that cannot be reached easily.

9.2.2. Ventilation

Ventilation openings must never be obstructed. The fans must be checked to make sure that they are functioning correctly. If any fan is replaced, also check if the fan rotates in the correct direction.

9.2.3. Filters

The filter mats must be checked at regular intervals (or at least every 6 months). If the mats are too dirty to allow the air supply to flow normally, they must be replaced.

9.2.4. Anti condensation heaters

Check the functionality of these heaters every three months and at least before first operation.

9.2.5. Cable and Screw Terminals

Cable and screw terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

9.2.6. Static load procedure

Static load will deteriorate the bearings of the jacking units. To assure the lifetime expectancy of the bearings, the jacking system should run for a (very) short period of time every half a year.

9.2.7. Motor / brakes / encoders / brake resistors

Take care of safety regulations and de-energize the VSD cabinets first before starting maintenance activities.

De-energizing VSD's:

- Wait for the DC link voltage to drop to zero (HMI screen).
- Press an emergency button.
- De-energize the jacking system.
- Switch off the VSD cabinets using the main switches in front VSD cabinets and lock them out.

Warning

- When measuring the insulation of the encoder cables; always disconnect the encoder and the SMC30 module first.
- When measuring the insulation of the motor cables; always disconnect the motor from its inverter module first.

9.3. HMI, PLC AND SOFTWARE

The HMI system consists of a Box PC with software, which communicates with the PLC. The jacking system is equipped with an operational Box PC located in the CCD.

Stop

If the software or HMI hardware will be changed by unauthorized people, this will void all warranty and may lead to dangerous situations causing injuries, deaths and/or serious impairment of the platform.

9.3.1. Consistency of the hardware (PLC related)

If a wrong module type is inserted (e.g. exchanged due module failure), led's on the PLC will indicate this. For more details, see S7-400_installation_e.pdf, section 7, which can be found in appendix D-7.

9.3.2. Consistency of the drive related hardware

If a wrong module is connected to the jacking drive system, this will be noticed by the CU320's. A failure code will appear. This code can be found in the "Sinamics S120 Equipment Manual", which can be found in appendix D-6. The fault code and remedy is explained here.

9.3.3. Defective Box PC hardware or software

Use the spare Box PC in the event of a defective Box PC. Contact Siemens or GustoMSC to install software on the spare Box PC and provide a new spare Box PC.

9.3.4. Replacing batteries of the PLC, BOX PC

Batteries PLC

Every two years, the PLC batteries need to be replaced. See Section 7 of the document “s7-400_installation_e”, which can be found in appendix D-7. Do not replace the battery when the power supply from PLC is switched off.

Warning

This is also applicable for the spare PLC. Replace only one battery at the same time or else the PLC will lose its settings and application software.

Batteries BOX PC

Every five years, the backup battery in the BOX PC shall be replaced. See section 7 of the document “GS_BoxPC627B_enu_en-US[1].pdf”, which can be found in appendix D-9.

9.4. BEFORE FIRST OPERATION

Complete the following checkups before first operation of the jacking system.

9.4.1. Bus bars and PE rails

Bus bar, and PE rail connections must be checked using the connection bolt temper evident indicators and if necessary (not aligned) retightened.

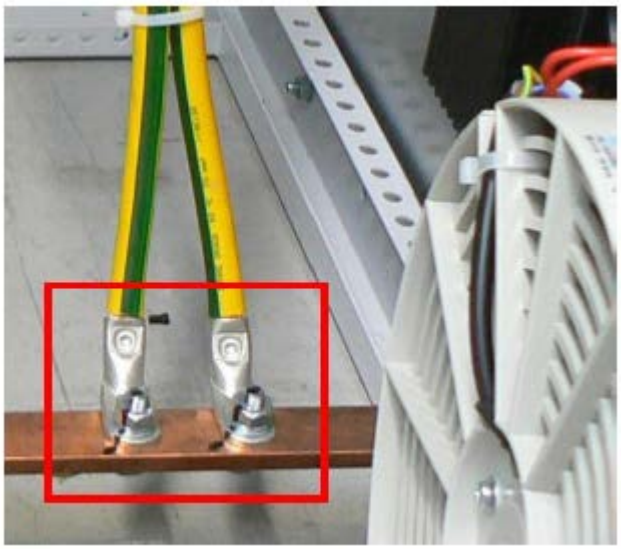


Figure 9-1: Torque adjustment

Retighten the bolt and nuts using the appropriate torque:

M12 = 70 Nm
M10 = 40 Nm

Always (use) check the presence of the dome or spring washers.

9.4.2. Inclination meter calibration

The inclination meter, located in the Control Cabinet needs to be calibrated. To calibrate the inclination meter, the platform needs to be leveled (third party measurements are required). An operator with level II authorization (see section 5.7) then needs to zero the measurements from the inclination meters. This can be done by using the HMI screens (operator level II required).

When finished, the system of axis is probably not correctly aligned with the platform. To fix this, the system of axis needs to be rotated to align it with the platform. This rotation angle needs to be determined manually, were after this value can be entered in the HMI system (operator level II).

To check if this procedure was successful, compare the third party measurement with that of the inclination meters located in the Control Cabinet (measurements can be verified using the small screen on the Central Control Desk).

9.5. PROLONGED SHUTDOWN

The following preparations shall be performed before a prolonged shutdown:

- Press an emergency button.
- De-energize the jacking system:
- Switch off all VSD cabinets using the main switches in front VSD cabinets and lock them out.
- **DO NOT** switch off the anti-condensation heating of the cabinets, motors or brakes.
- **DO NOT** switch off the UPS power.

The following steps shall be executed during a prolonged shutdown:

- Each half year execute the static load procedure mentioned in section 9.2.6.
- Once a year replace the PLC batteries, for the procedure see section 9.3.4.
- Replace the BOX PC batteries each five years, for the procedure see section 9.3.4.

These are the procedures for starting up the jacking system after a prolonged shutdown:

- Follow the general maintenance procedures as described in section 9.2.1 to 9.2.5.
- Carry out the forming procedure for the rectifiers, described in Chapter 8.5 of the “Sinamics S120 Equipment Manual”, which can be found in appendix D-6. Performing this procedure is only necessary if the system has not been used for two years.
- Energize the VSD cabinets using the main switches.
- Disable all emergency stops.
- Check the inclinometer values, see section 9.4.2.
- Check the system for errors and follow the reset procedure as described in section 6.11.

APPENDIX A

Mechanical arrangements

1.	Jacking system – General Arrangement	11807-10005-001
2.	Jacking system – Jacking Frame – General Arrangement	11807-10005-300
3.	Jacking system – Jacking Unit And Frame Installation Site Manual	11807-10800

APPENDIX B

Weight summary

1.	Jacking system – Weight Summary – Report	11807-10784

APPENDIX C

E&I drawings and diagrams

1. Common
   i. General Arrangement
   ii. Single Lines
   iii. Cause & Effect Diagram
2. Central Control Desk
3. Control Cabinet
4. VSD Cabinet Layer 1
5. VSD Cabinet Layer 2
6. VSD Cabinet Layer 3
7. Local Control Panel 1
8. Local Control Panel 2
9. Local Control Panel 3
10. Local Control Panel 4

APPENDIX D

E&I equipment data

1. Motor
2. Brakes
3. Encoders
4. Transformers
5. Braking Resistors
6. VSD Cubicles
7. Control Cabinet
8. Local Control Panels
9. Central Control Console
10. Inclinometer
11. Bill of materials
12. Shockpad Load Measurement

APPENDIX E

Utility consumption

1. Jacking system – Utility Consumption / Generated heat / Load – List 11807-10786

APPENDIX F

Lubrication and other liquids; datasheets