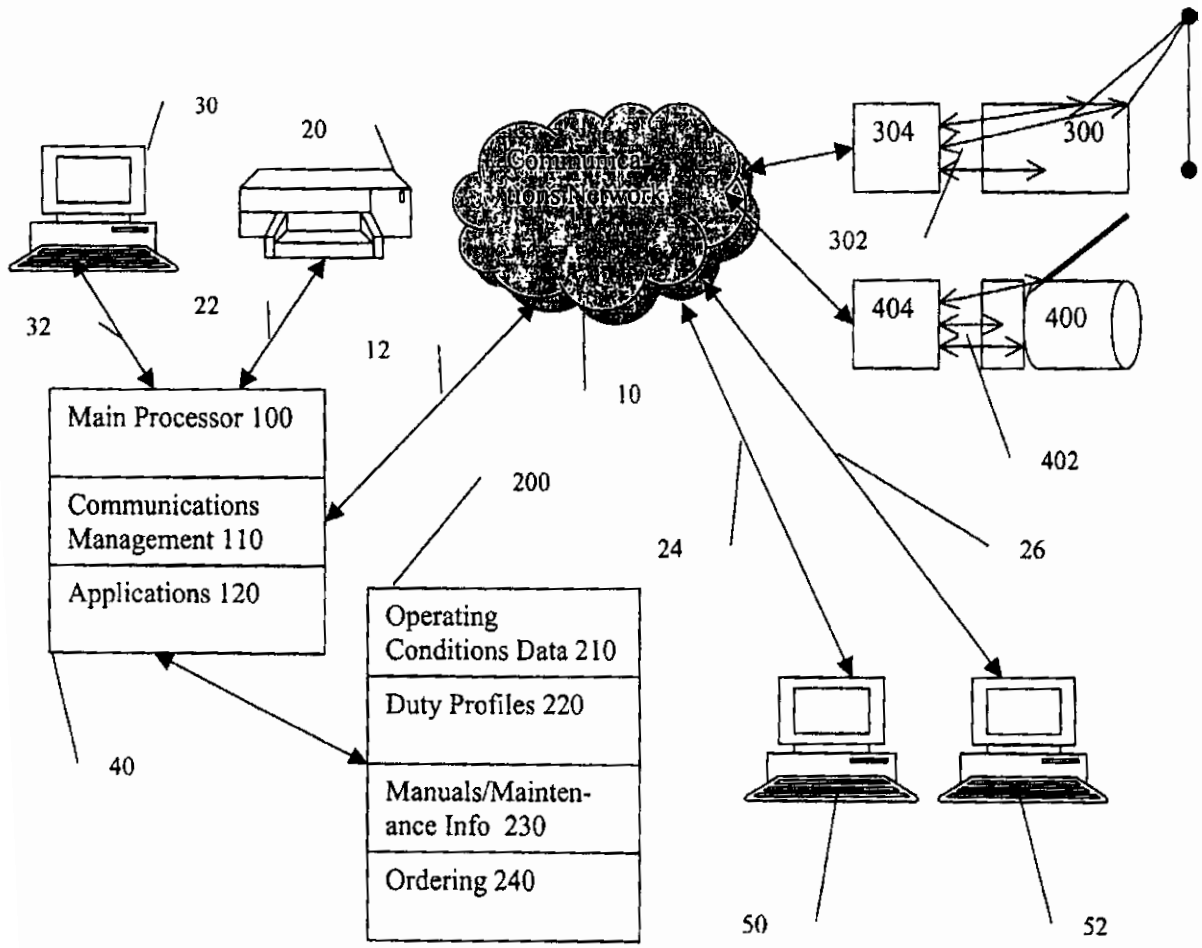

30
20
Commercial Radio Network
304
300
302
404
400
402
32
22
12
10
Main Processor 100
Communications Management 110
Applications 120
200
24
26
Operating Conditions Data 210
Duty Profiles 220
Manuals/Maintenance Info 230
Ordering 240
40
50
52

FIG. 1

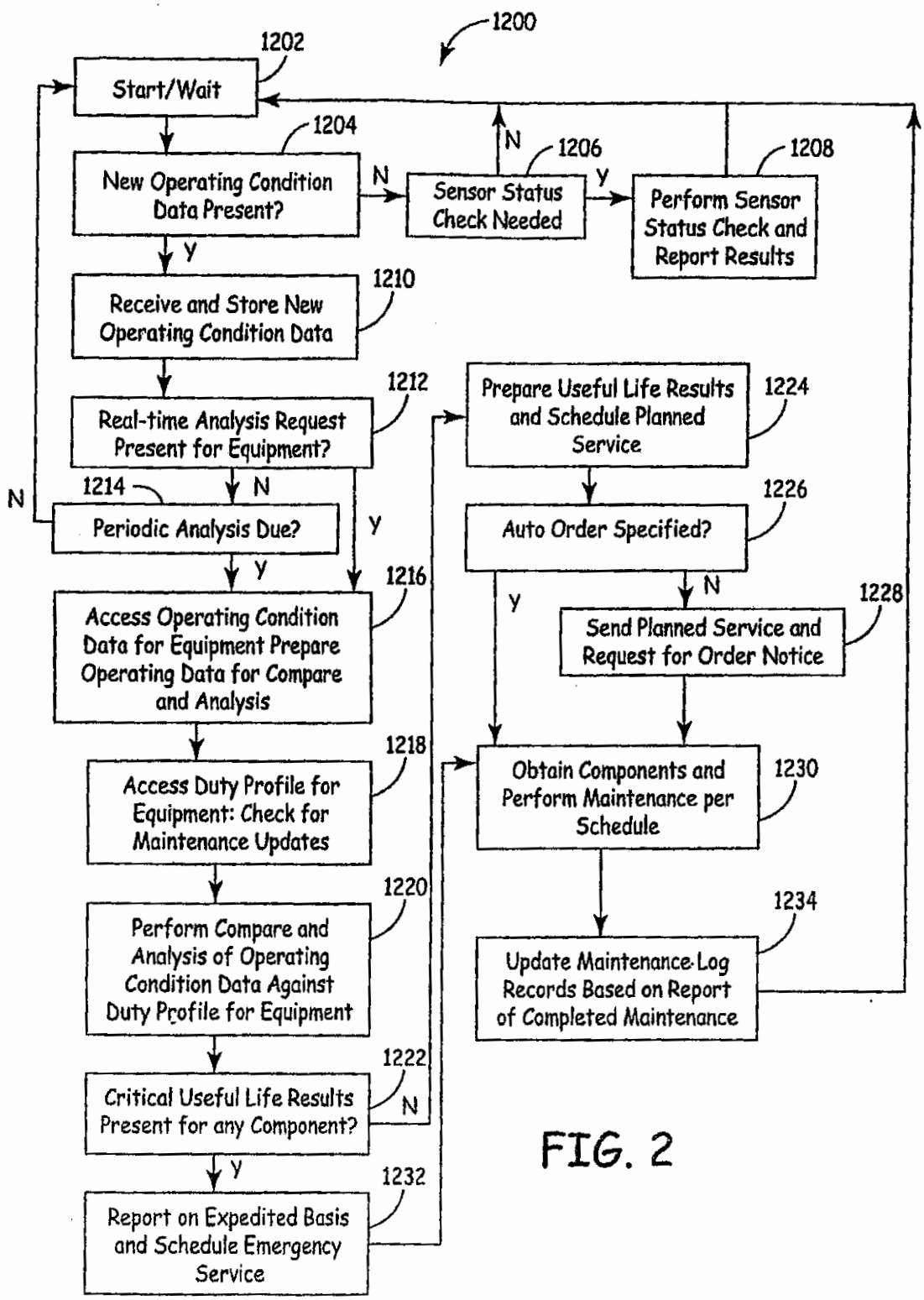

1200
1202
Start/Wait
1204
New Operating Condition Data Present?
N
1206
Sensor Status Check Needed
N
Y
1208
Perform Sensor Status Check and Report Results
Y
1210
Receive and Store New Operating Condition Data
1212
Real-time Analysis Request Present for Equipment?
N
1214
Periodic Analysis Due?
N
Y
Y
1216
Access Operating Condition Data for Equipment Prepare Operating Data for Compare and Analysis
1218
Access Duty Profile for Equipment: Check for Maintenance Updates
1220
Perform Compare and Analysis of Operating Condition Data Against Duty Profile for Equipment
1222
Critical Useful Life Results Present for any Component?
N
Y
1232
Report on Expedited Basis and Schedule Emergency Service
1224
Prepare Useful Life Results and Schedule Planned Service
1226
Auto Order Specified?
Y
N
1228
Send Planned Service and Request for Order Notice
1230
Obtain Components and Perform Maintenance per Schedule
1234
Update Maintenance Log Records Based on Report of Completed Maintenance

FIG. 2

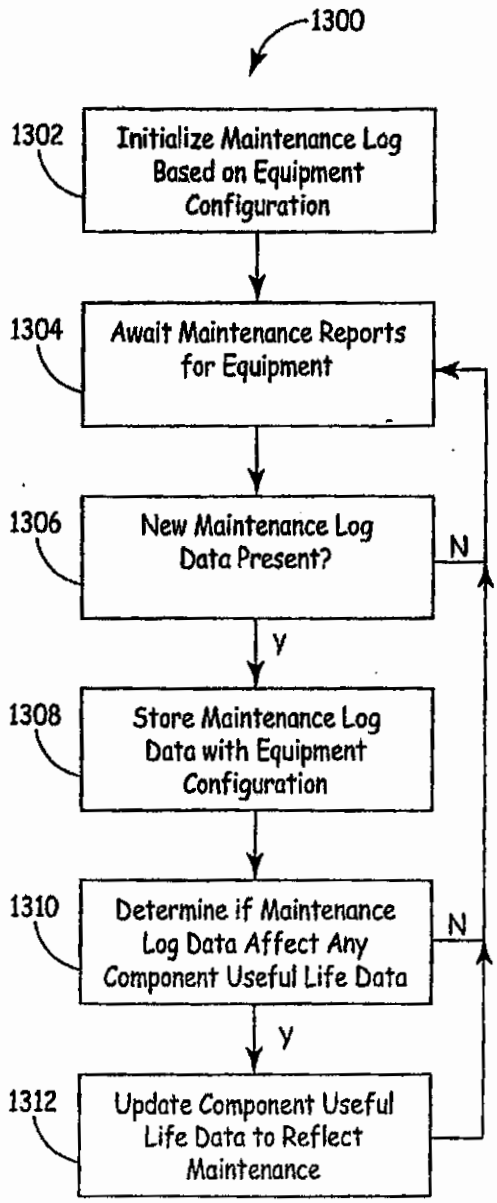

1300
1302
Initialize Maintenance Log Based on Equipment Configuration
1304
Await Maintenance Reports for Equipment
1306
New Maintenance Log Data Present?
N
Y
1308
Store Maintenance Log Data with Equipment Configuration
1310
Determine if Maintenance Log Data Affect Any Component Useful Life Data
N
Y
1312
Update Component Useful Life Data to Reflect Maintenance

FIG. 3

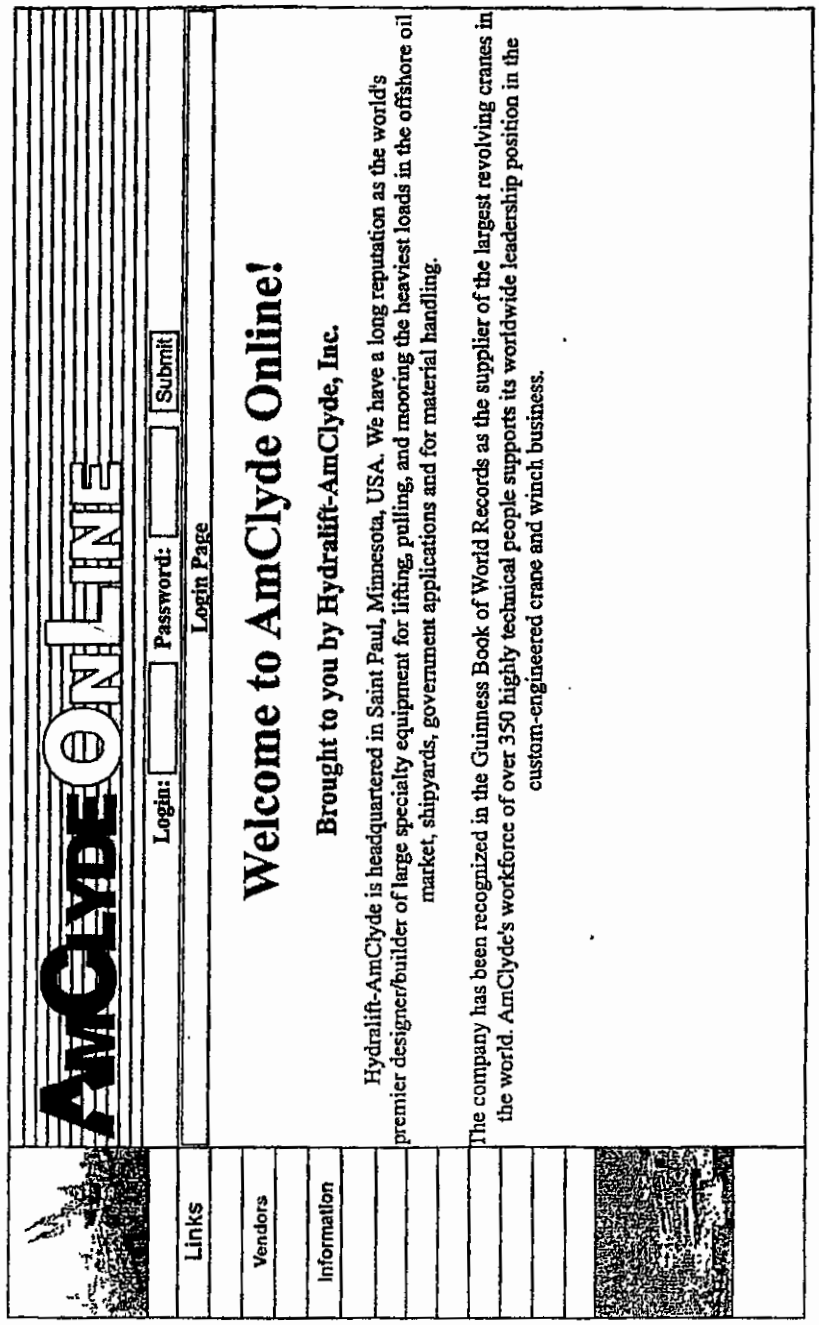

AMCLYDE ONLINE
Login:
Password:
Submit
Login Page
Links
Vendors
Information
Welcome to AmClyde Online!
Brought to you by Hydralift-AmClyde, Inc.
Hydralift-AmClyde is headquartered in Saint Paul, Minnesota, USA. We have a long reputation as the world's premier designer/builder of large specialty equipment for lifting, pulling, and mooring the heaviest loads in the offshore oil market, shipyards, government applications and for material handling.
The company has been recognized in the Guinness Book of World Records as the supplier of the largest revolving cranes in the world. AmClyde's workforce of over 350 highly technical people supports its worldwide leadership position in the custom-engineered crane and winch business.

FIG. 4a

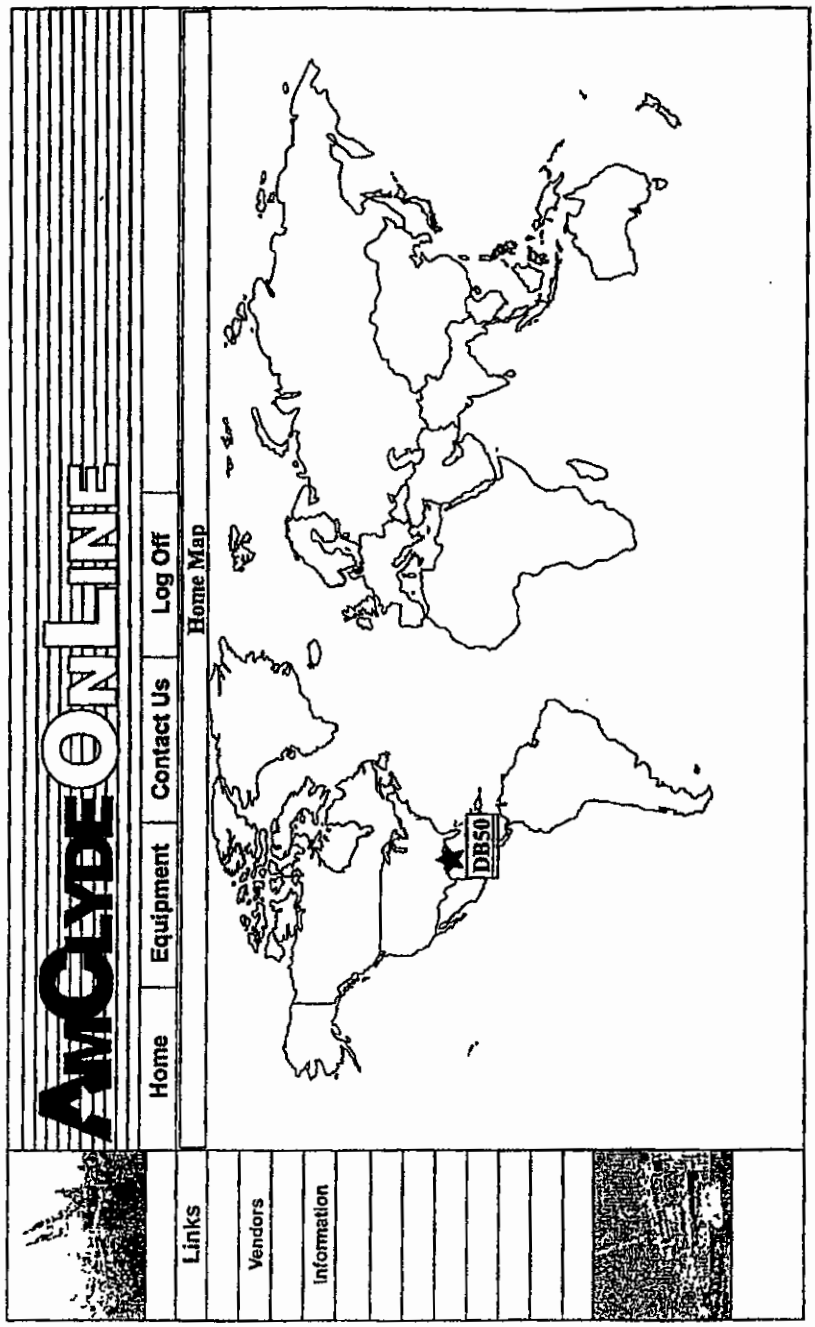

AMCYDE ONLINE
Home
Equipment
Contact Us
Log Off
Home Map
Links
Vendors
Information
DB50

FIG. 4b

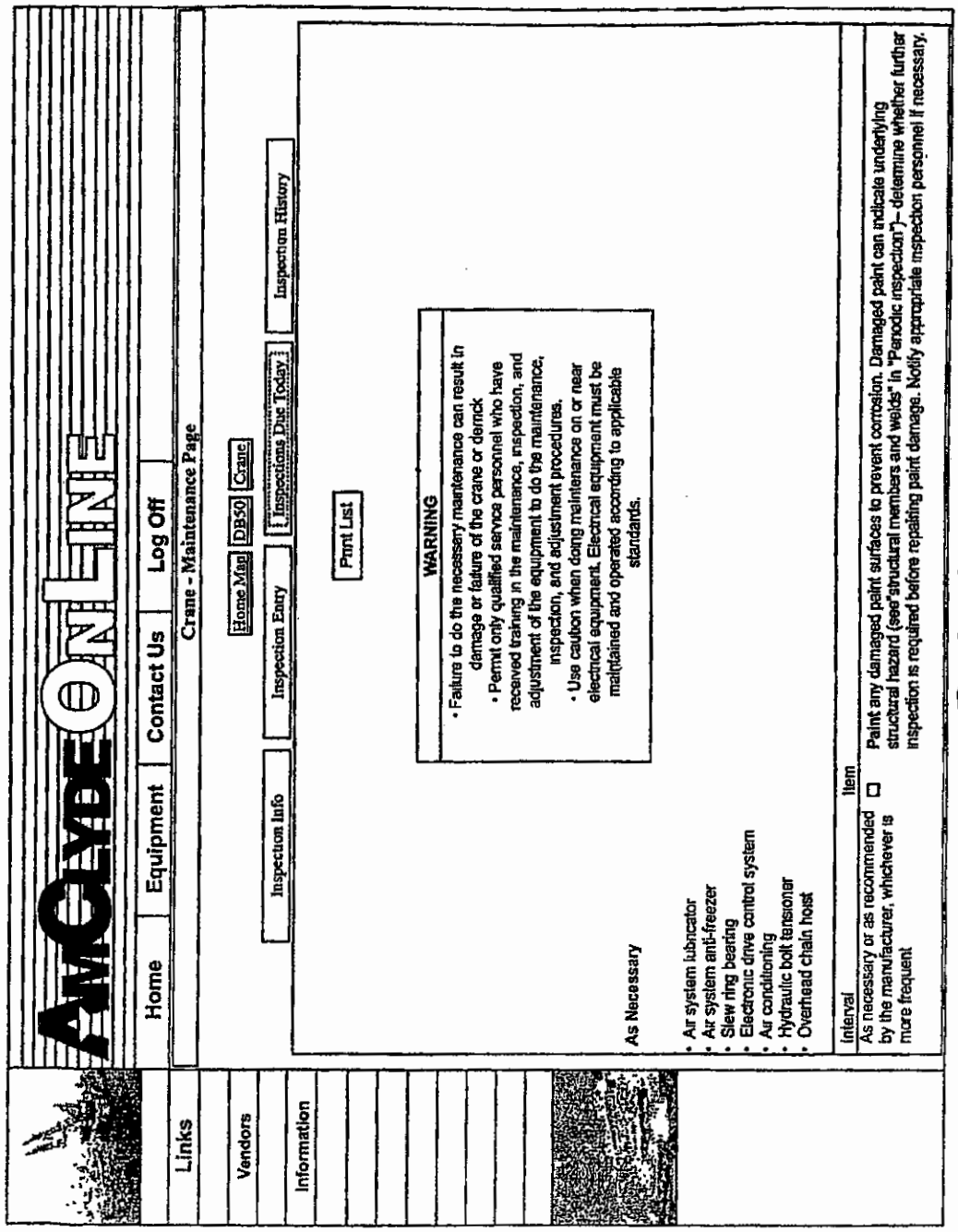

AMCYDE ONLINE
Home
Equipment
Contact Us
Log Off
Links
Crane - Maintenance Page
Vendors
Home Mag
DB50
Crane
Information
Inspection Info
Inspection Entry
Inspections Due Today!
Inspection History
Print List
WARNING
• Failure to do the necessary maintenance can result in damage or failure of the crane or derrick
• Permit only qualified service personnel who have received training in the maintenance, inspection, and adjustment of the equipment to do the maintenance, inspection, and adjustment procedures.
• Use caution when doing maintenance on or near electrical equipment. Electrical equipment must be maintained and operated according to applicable standards.
As Necessary
• Air system lubricator
• Air system anti-freezer
• Slew ring bearing
• Electronic drive control system
• Air conditioning
• Hydraulic bolt tensionar
• Overhead chain hoist
Interval
Item
As necessary or as recommended by the manufacturer, whichever is more frequent
Paint any damaged paint surfaces to prevent corrosion. Damaged paint can indicate underlying structural hazard (see"structural members and welds" in "Periodic inspection")– determine whether further inspection is required before repairing paint damage. Notify appropriate inspection personnel if necessary.

FIG. 4c

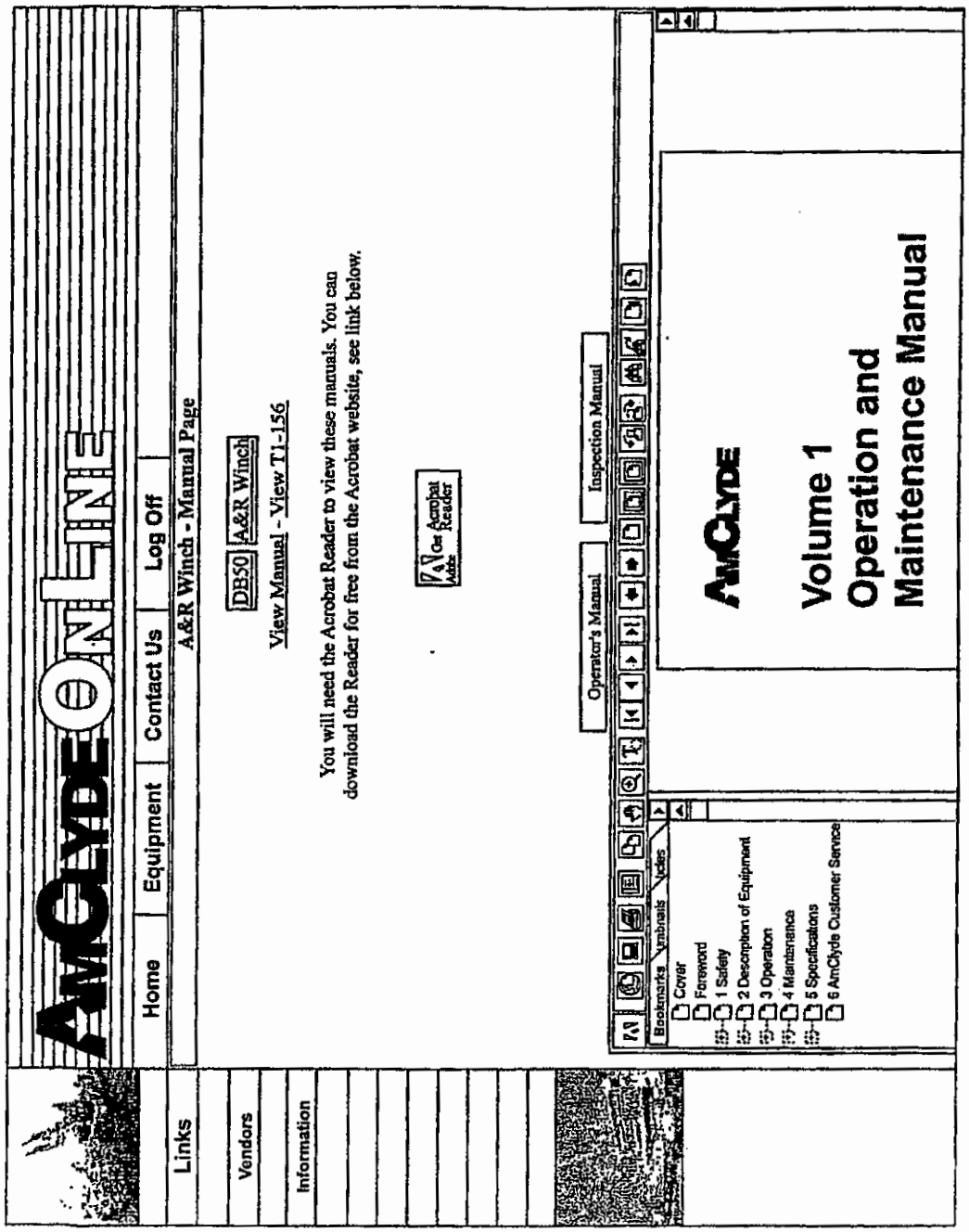

AMCLYDE ONLINE
Home
Equipment
Contact Us
Log Off
A&R Winch - Manual Page
Links
Vendors
Information
DB50
A&R Winch
View Manual - View T1-156
You will need the Acrobat Reader to view these manuals. You can download the Reader for free from the Acrobat website, see link below.
Get Acrobat Reader
Operator's Manual
Inspection Manual
Bookmarks
Thumbnails
Notes
Cover
Foreword
1 Safety
2 Description of Equipment
3 Operation
4 Maintenance
5 Specifications
6 AmClyde Customer Service
AMCLYDE
Volume 1
Operation and
Maintenance Manual

FIG. 4d

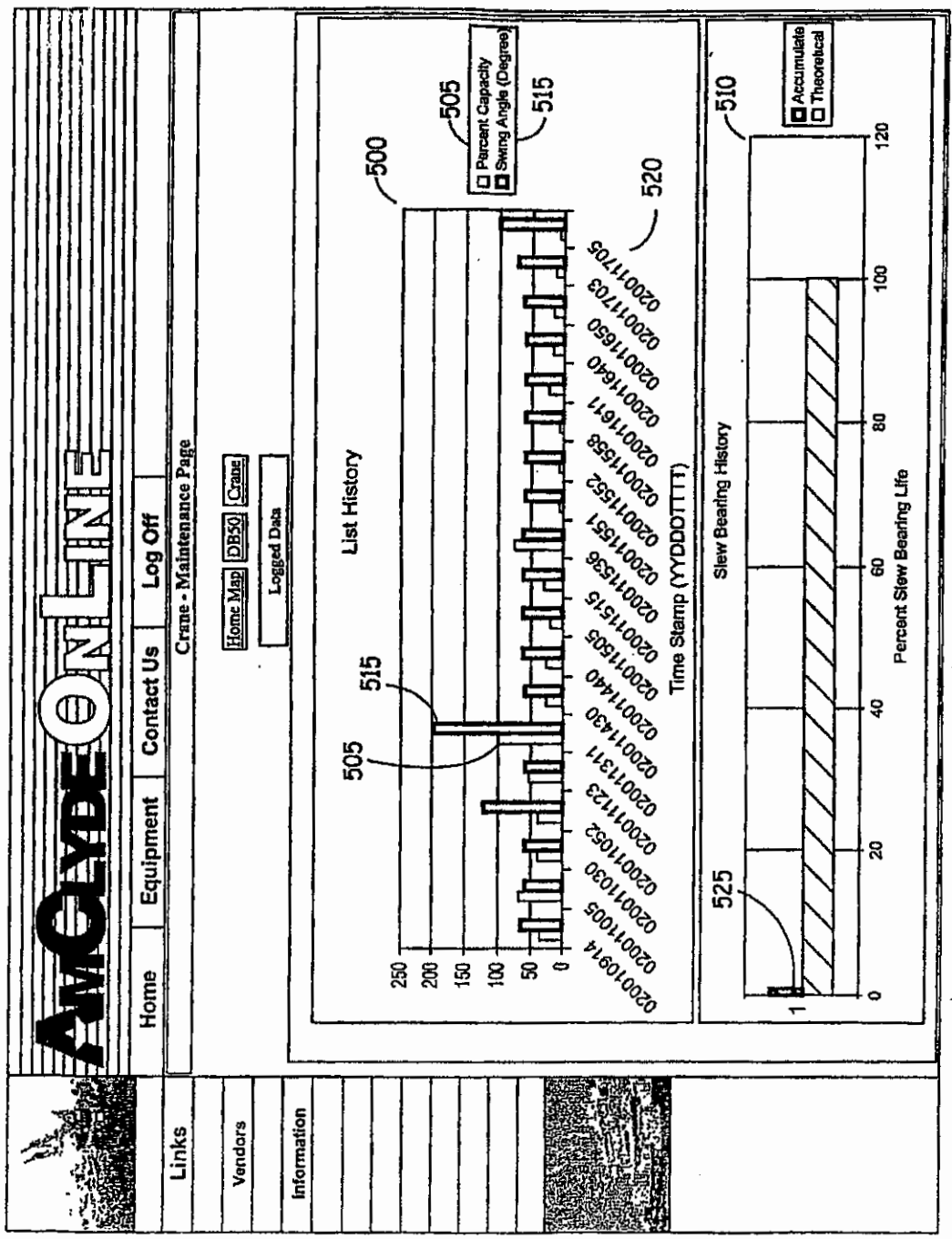
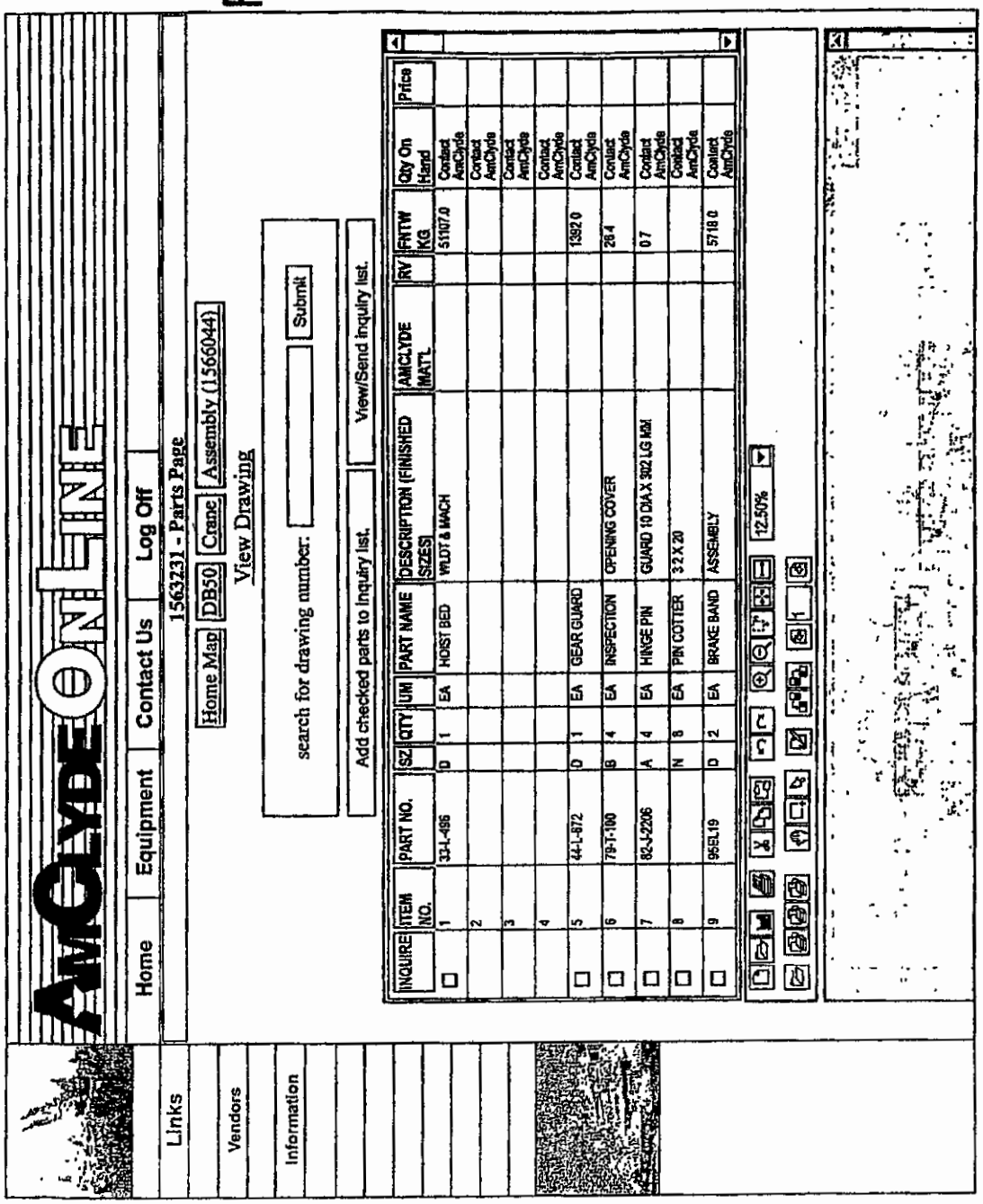

AMCLYDE ONLINE
Home
Equipment
Contact Us
Log Off
Crane - Maintenance Page
Home Map
DB50
Crane
Logged Data
Links
Vendors
Information
List History
500
505
515
Percent Capacity
Swing Angle (Degree)
520
Time Stamp (YYDDDTTTT)
Slew Bearing History
510
525
Accumulate
Theoretical
Percent Slew Bearing Life

FIG. 4e

FIG. 4f


AMCLYDE ONLINE
Home
Equipment
Contact Us
Log Off
Links
1563231 - Parts Page
Home Map
DB50
Crane
Assembly (1566044)
View Drawing
search for drawing number:
Submit
Vendors
Information
Add checked parts to Inquiry list.
View/Send Inquiry list.
INQUIRE
ITEM NO.
PART NO.
SZ
QTY
UM
PART NAME
DESCRIPTION (FINISHED SIZES)
AMCLYDE MATL
RV
FNTW KG
Qty On Hand
Price
1 33-I-496 D 1 EA HOIST BED WLDT & MACH 51107.0 Contact AmClyde
2 Contact AmClyde
3 Contact AmClyde
4 Contact AmClyde
5 44-L-872 D 1 EA GEAR GUARD 1392.0 Contact AmClyde
6 79-T-100 B 4 EA INSPECTION OPENING COVER 264 Contact AmClyde
7 82-J-2206 A 4 EA HINGE PIN GUARD 10 DIA X 302 LG MM 07 Contact AmClyde
8 N 8 EA PIN COTTER 3 2 X 20 Contact AmClyde
9 95EL19 D 2 EA BRAKE BAND ASSEMBLY 5718.0 Contact AmClyde
12.50%

Actual Duty Profile For Equipment X				
Usage Case	Component A (rotating shaft)	Component B (hydraulic ram)	Component C (sheave)	Profile Usage Case Occurrences Over Useful Lifespan of Equipment
1	C1 (1,000 ft. lbs.)	C2 (50 ft. lbs.)	C3 (na)	N1 (100)
2	C4 (na)	C5 (500 ft. lbs.)	C6 (1,000)	N2 (50)
3	C7 (3,000 ft. lbs.)	C8 (2,000 ft. lbs.)	C9 (6,000)	N3 (125)
Theoretical Component Usage Profile (TCUP)	N1 x C1 + N2 x C4 + N3 x C7 = $TCUP_A$ (475,000 ft. lbs.)	N1 x C2 + N2 x C5 + N3 x C8 = $TCUP_B$ (280,000 ft. lbs.)	N1 x C3 + N2 x C6 + N3 x C9 = $TCUP_C$ (800,000 ft. lbs.)	
Wear/Stress/Strain rating (WSSR) of actual component utilized in Equipment A	$WSSR_A$ (475,000 ft. lbs.)	$WSSR_B$ (392,000 ft. lbs.)	$WSSR_C$ (400,000 ft. lbs.) Note: for the effective $WSSR_C$, multiply 400k by two because two Component C's are needed to reach the 800k TCUPC	
Theoretical Component Useful Life Under Assumed Duty Profile for a single Component	25 years	35 years	12.5 years	

FIG. 5

Actual Duty Profile For Equipment X				
Usage Case	Component A (rotating shaft)	Component B (hydraulic ram)	Component C (sheave)	Actual Profile Usage Case Occurrences Over Past Two Years
1	C1 (1,000 ft. lbs.)	C2 (50 ft. lbs.)	C3 (na)	N1 (10)
2	C4 (na)	C5 (500 ft. lbs.)	C6 (1,000)	N2 (5)
3	C7 (10,000 ft. lbs.)	C8 (500 ft. lbs.)	C9 (6,000)	N3 (12)
Actual Component Usage (ACU)	N1 x C1 + N2 x C4 + N3 x C7 = ACU_A (130,000 ft. lbs.)	N1 x C2 + N2 x C5 + N3 x C8 = ACU_B (9,000 ft. lbs.)	N1 x C3 + N2 x C6 + N3 x C9 = ACU_C (77,000 ft. lbs.)	
Theoretical Life Used in Two Years (TLU_{2Y})	($TCUP_A$/ selected design lifetime) x actual years of use = TLU_{2Y} (38,000)	($TCUP_B$/ selected lifetime) x actual years of use = TLU_{2Y} (22,400)	($TCUP_C$/ selected design lifetime) x actual years of use = TLU_{2Y} (64,000)	
Actual Percent of Life Used	ACU_A / $WSSR_A$ = % Life Used for Comp. A (27%)	ACU_B / $WSSR_B$ = % Life Used for Comp. B (2%)	ACU_C / $WSSR_B$ = % Life Used for Comp. C (10%)	

FIG. 6

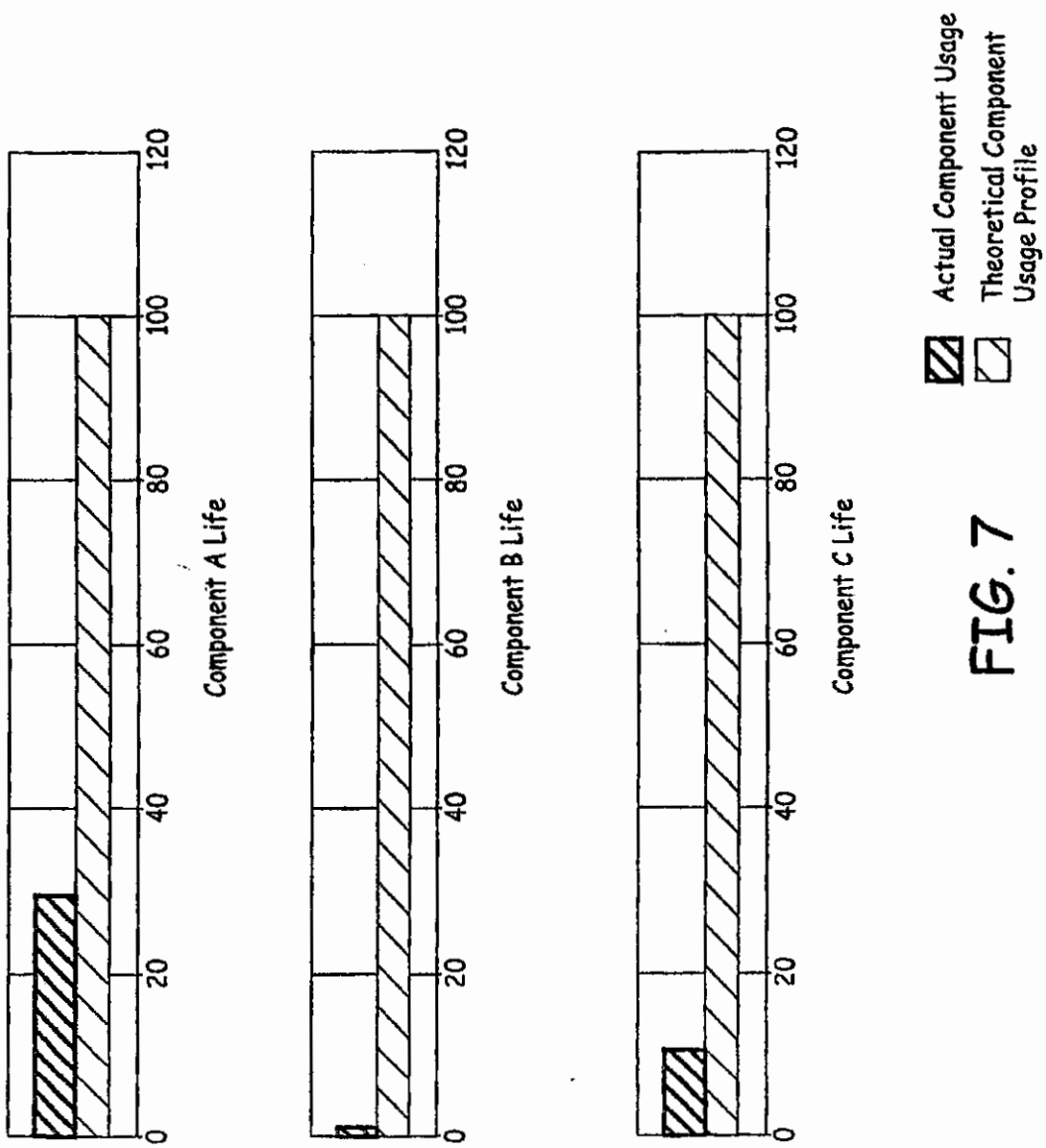

Component A Life
Component B Life
Component C Life
0
20
40
60
80
100
120
Actual Component Usage
Theoretical Component Usage Profile

FIG. 7

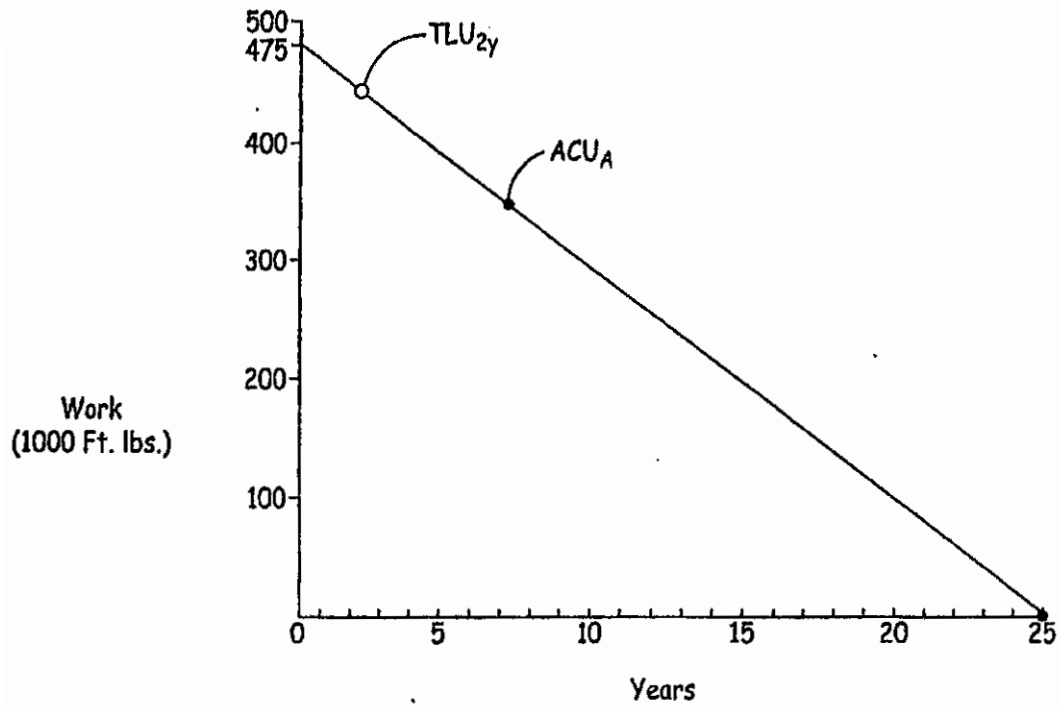

500
475
400
300
200
100
Work
(1000 Ft. lbs.)
TLU2y
ACUA
0
5
10
15
20
25
Years

FIG. 8

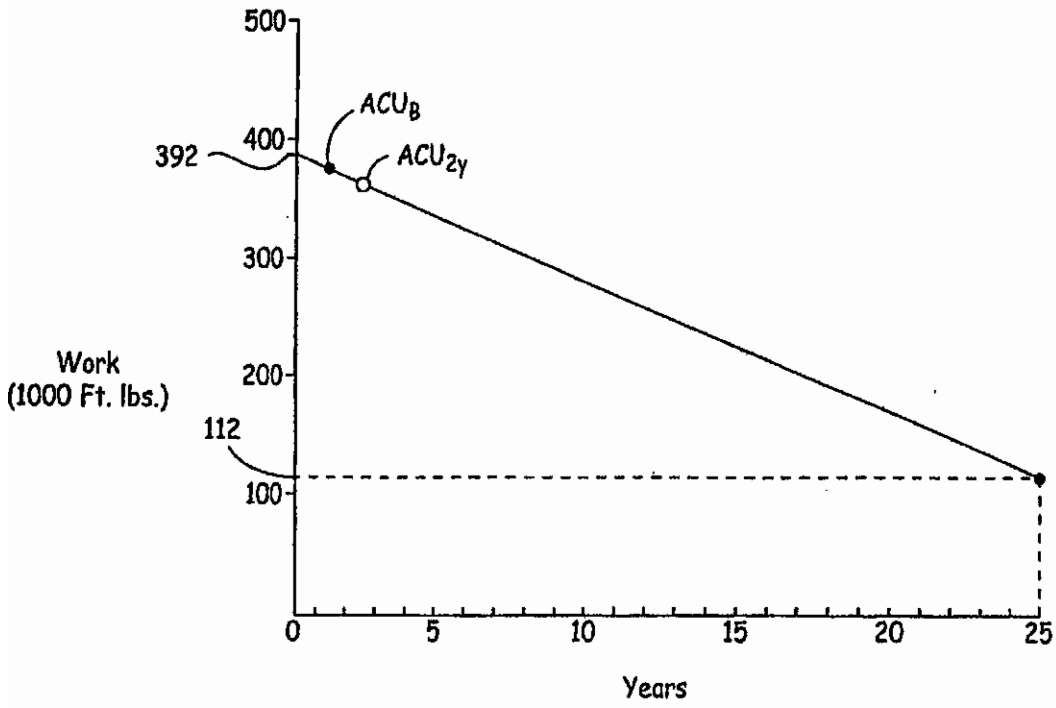

500
400
300
200
100
392
112
ACU_B
ACU_{2Y}
Work
(1000 Ft. lbs.)
0
5
10
15
20
25
Years

FIG. 9

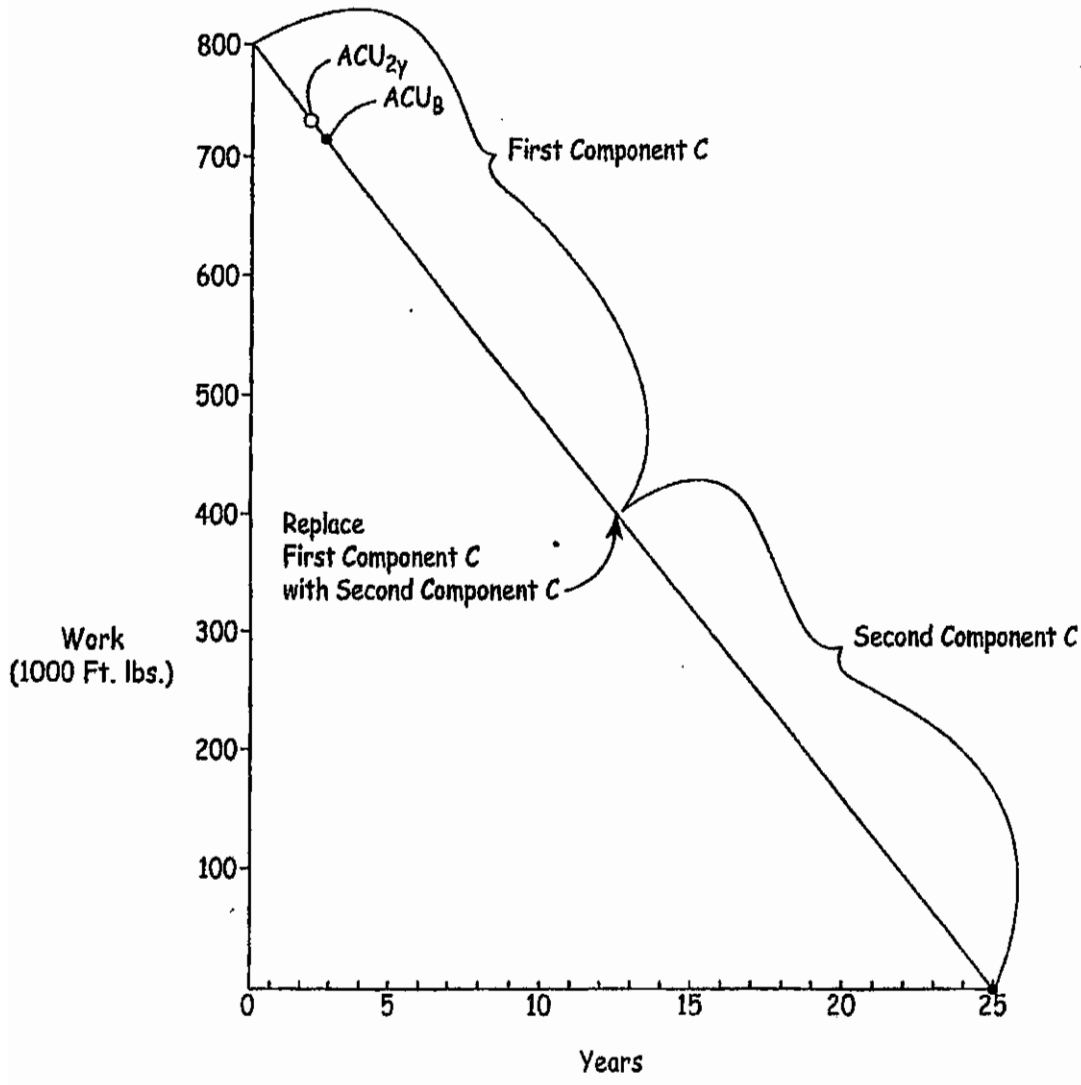

800
700
600
500
400
300
200
100
0
5
10
15
20
25
Work
(1000 Ft. lbs.)
Years
ACU_{2Y}
ACU_B
First Component C
Replace
First Component C
with Second Component C
Second Component C

FIG. 10

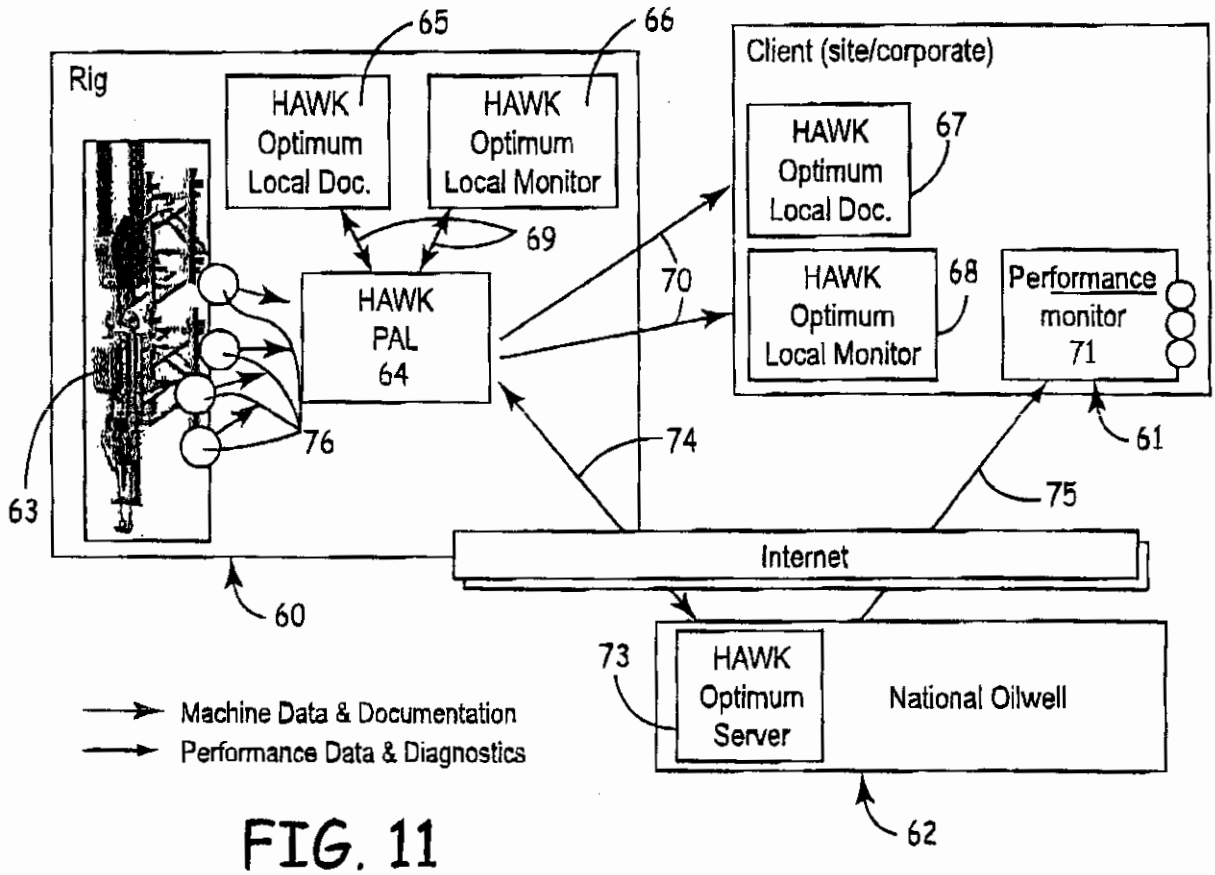

Rig
HAWK Optimum Local Doc.
HAWK Optimum Local Monitor
HAWK PAL 64
Client (site/corporate)
HAWK Optimum Local Doc.
HAWK Optimum Local Monitor
Performance monitor 71
Internet
HAWK Optimum Server
National Oilwell
Machine Data & Documentation
Performance Data & Diagnostics
65
66
67
68
69
70
74
75
76
63
60
61
73
62

FIG. 11

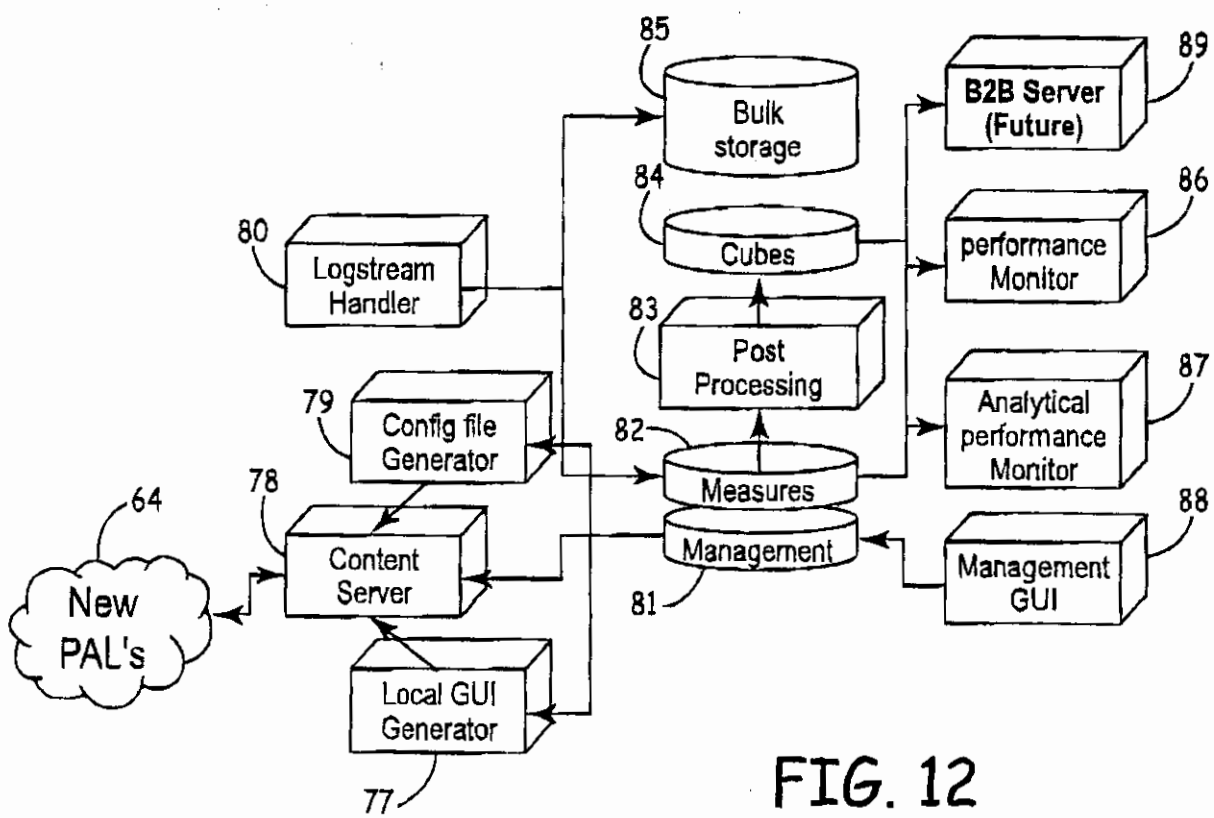

Bulk storage
B2B Server (Future)
Cubes
performance Monitor
Logstream Handler
Post Processing
Config file Generator
Analytical performance Monitor
Measures
Content Server
Management
Management GUI
New PAL's
Local GUI Generator
85
89
84
86
80
83
79
87
82
78
64
88
81
77

FIG. 12

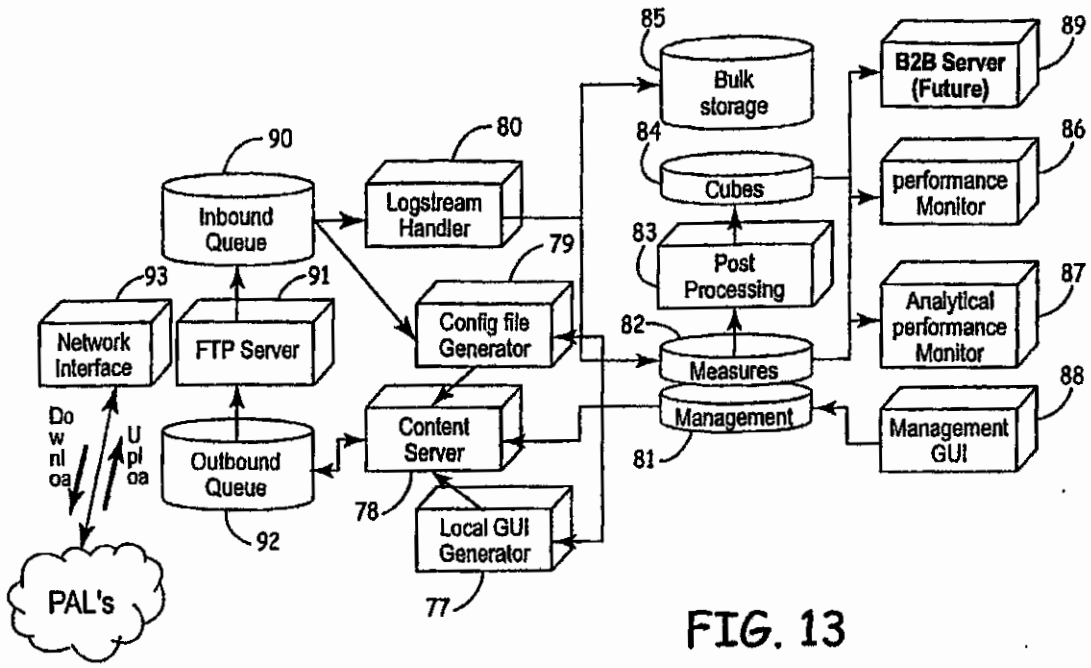

Bulk storage
B2B Server (Future)
Cubes
performance Monitor
Post Processing
Analytical performance Monitor
Measures
Management
Management GUI
Inbound Queue
Logstream Handler
Config file Generator
Network Interface
FTP Server
Content Server
Outbound Queue
Local GUI Generator
Download
Upload
PAL's
85
89
84
86
83
87
82
88
81
90
80
79
93
91
78
92
77

FIG. 13

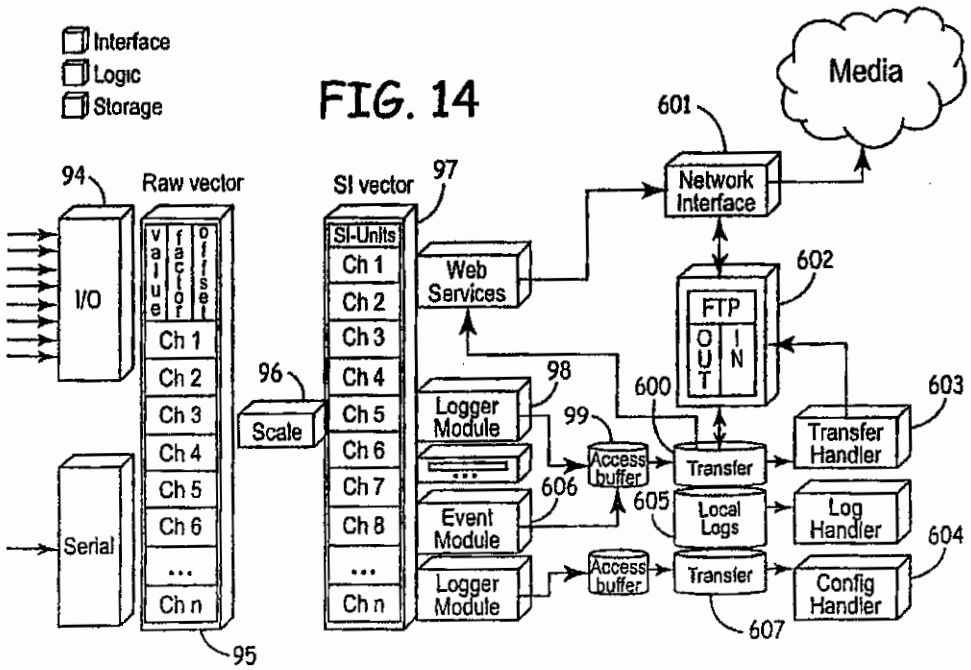
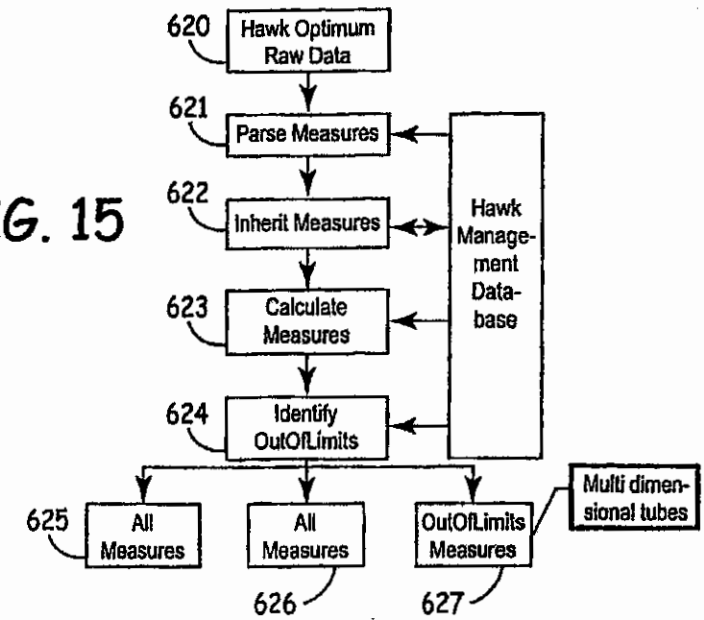

Interface
Logic
Storage
Media
Raw vector
SI vector
I/O
Serial
Scale
Web Services
Network Interface
FTP
OUT
IN
Logger Module
Event Module
Logger Module
Access buffer
Access buffer
Transfer
Transfer
Local Logs
Transfer Handler
Log Handler
Config Handler
SI-Units
Ch 1
Ch 2
Ch 3
Ch 4
Ch 5
Ch 6
Ch 7
Ch 8
Ch n
94
97
96
98
99
600
601
602
603
604
605
606
607
95

FIG. 14

FIG. 15



EXAMPLE HEX MUD PUMP
Logged data:

Press_Pushrod_Actual	MPa
Press_Change	Bar
Press_Discharge	MPa
FaultCode_Drive A	
FaultCode_DriveB	
Temp_ClosedLoopOil	Celsius
Jog Switch	**0/1**
Leak_Cyl	#
Leak_Percent	%
Press_LinerWash	Bar
Hours_LoadWeighted	Hr
Press_LubeOil	Bar
Temp_LubeOil_Hi	Celsius
Temp_MortoA_BearingD	Celsius
Temp_MotorA_StatorA	Celsius
Temp_MotorA_StatorB	Celsius
Temp_MotorA_BearingND	Celsius
Temp_MotorB_BearingD	Celsius
Temp_MotorB_StatorA	Celsius
Temp_MotorB_StatorB	Celsius
Temp_MotorB_BearingND	Celsius
MP On (Start/Stop)	**1/0**
Temp_Mud	DegC
Hours_Running	Hr
Service Mode Switch (0-7)	**Number**
Press_Pushrod_Set	MPa
SPM	SPM
Strokes_Total	STK
Torque_MotorA	Nm
Torque_MotorB	Nm
Temp_CoolWater_Lo	Celsius
Temp_CoolWater_Hi	Celsius
Temp_LubeOil_Lo	Celsius
Flow_CoolWater	LPM
Flow_LubeOil	LPM

FIG. 16

Constants and help factors:				
Number of cylinders	n_cyl	6		
Liner diameter	ID_liner	4,5	in	
Rated pump speed	S_rated	212	spm	
Rated pressure	p_rated	517,1	bar	
Rated motor torque (per motor)	Trq_rated	11200	Nm	
Nominal motor speed	N_nom	810	rpm	
Pinion teeth number	teeth_P	34		
Gear teeth number	teeth_g	249		
Piston stroke	s_piston	300	mm	
Residual volume factor	c-resV	1,14		
Valve delay	t_delay	0,007	s	
Loss stroke from valve seal cushion	s_vc	1,7	mm	
Mud compressibility	C-mud	4,4E-05	1/bar	
Bearing load exponent	e	3,33		
Reference speed	S_ref	74	spm	
Reference pressure	P_ref	260	bar	
Density of lube oil	rho_oil	860	kg/m3	
Density of cooling water	rho_w	1000	kg/m3	
Specific heat capacity of lube oil	c_oil	1950	J/kg/K	
Specific heat capacity of cooling water	cw	4180	J/kg/K	
Rated motor power (both motors)	P_rated	1900	kW	= 2*N_nom*PI()/30*T_rated/1000
Stroke volume per cylinder	V_cyl	3,078	litres	= PI()/4*(ID_liner*0.0254)^2*s_piston
Gear ratio (motor speed/cam speed)	n_gear	7,324		= teeth_g/teeth_p
Load factor for lowest ref. load	w_D	0.711		=((ID_liner/4.5)^2*(2*p_ref/p_rated))^e * (2*S_ref/S_rated)
Weighted mean reference load factor	w_ref	1,935		= w_0*(0.15*2^e + 0.4 + 0.4*2 + 0.05*(0.5)^e *Srated/S_ref)

Post processed log parameters:				
Normalized motor torque difference	diff_Trqn	%	= 100*(Trq_A+Trq_B)/Trq_rated
Mech. power (from motor shafts)	P_mech	kW	= (Trq_A+Trq_B)*S_pump*PI()/30*n_gear/1000
Nominal pump rate	Q_nom	lpm	= n_cyl*V_cyl*S_pump
Calculated volumetric efficiency	eta_V	%	= 100*(1 - (p_disch-p_charge)*C_mud*(0.5+c_resV) - 2*s_vc/s_piston - (t_delay*S_pump)^2/120)
Flow out	Q_out	lpm	= eta_V/100*Q_nom
Hydraulic power	P_hyd	kW	= (p_disch-p_charge)*Q_out/600
Cooling power oil	P_cool_w	kW	= (T_oil_in - T_oil_out)*cw*rho_w*Q_oil/600
Cooling power water	P_cool_oil	kW	= (T_water_out - T_water_in)*cw*rho_w*Q_coolw/600
Pump efficiency	eta_pump	%	= 100*P_hyd/(P_mech)
Relative pump power	P_rel	%	= 100*P_mech/P_rated
Load factor	w		= (2*p_disch/p_rated)^e * (2*S_pump/S_rated)
Pump running	r	0/1	= IF(S_pump<0.02*S_rated; 0; 1)
Accumulated running hours	t_hr	hr	= t_hr + r*delta_t/3600
Acc. load weighted running hours	t_hrw	hr	= t_hrw + r*w*delta_t/3600

Definitions of input variables:	
delta_t	- time since previous sample (s)
p_charge	- charge pressure (bar)
p_disch	- discharge pressure (bar)
S_pump	- pump speed (spm)
Trq_A	- Torque from motor A (Nm)
Trq_B	- Torque from motor B (Nm)
T_oil_in	- temperature of lub oil into cooler (degC)
T_oil_out	- temperature of lub oil out of cooler (degC)
T_water_in	- temperature of lub oil into cooler (degC)
T_water_out	- temperature of lub oil out of cooler (degC)
Q_oil	- flow of tube oil (lmp)
Q_water	- flow of cooling water (lpm)

FIG. 17

SUBSTITUTE SHEET (RULE 26)

Performance Limits

Limit ID	Limit Description	Logical Operator	Value
1	80.0 ChargePressLoLoLim	≤	1.4
2	76.0 ChargePressLoLim	≤	1.5
3	88.0 ChargePressHiHiLim	≥	5.2
4	84.0 ChargePressLHiLim	≥	4.6
5	44.0 ClosedLoopTempLoLim	≤	10
6	48.0 ClosedLoopTempLoLoLim	≤	5
7	56.0 ClosedLoopTempHiHiLim	≥	70
8	52.0 ClosedLoopTempHiLim	≥	65
9	40.0 LinerWashPressLoLoLim	≤	0.2
10	36.0 LinerWashPressLoLim	≤	0.5
11	8.0 Lube Oil PressLoLoLim	≤	0.5
12	4.0 LubeOilPressLoLim	≤	1
13	16.0 LubeOilPresHiHiLim	≥	4
14	12.0 LubeOilPressHiLim	≥	3.5

FIG. 18

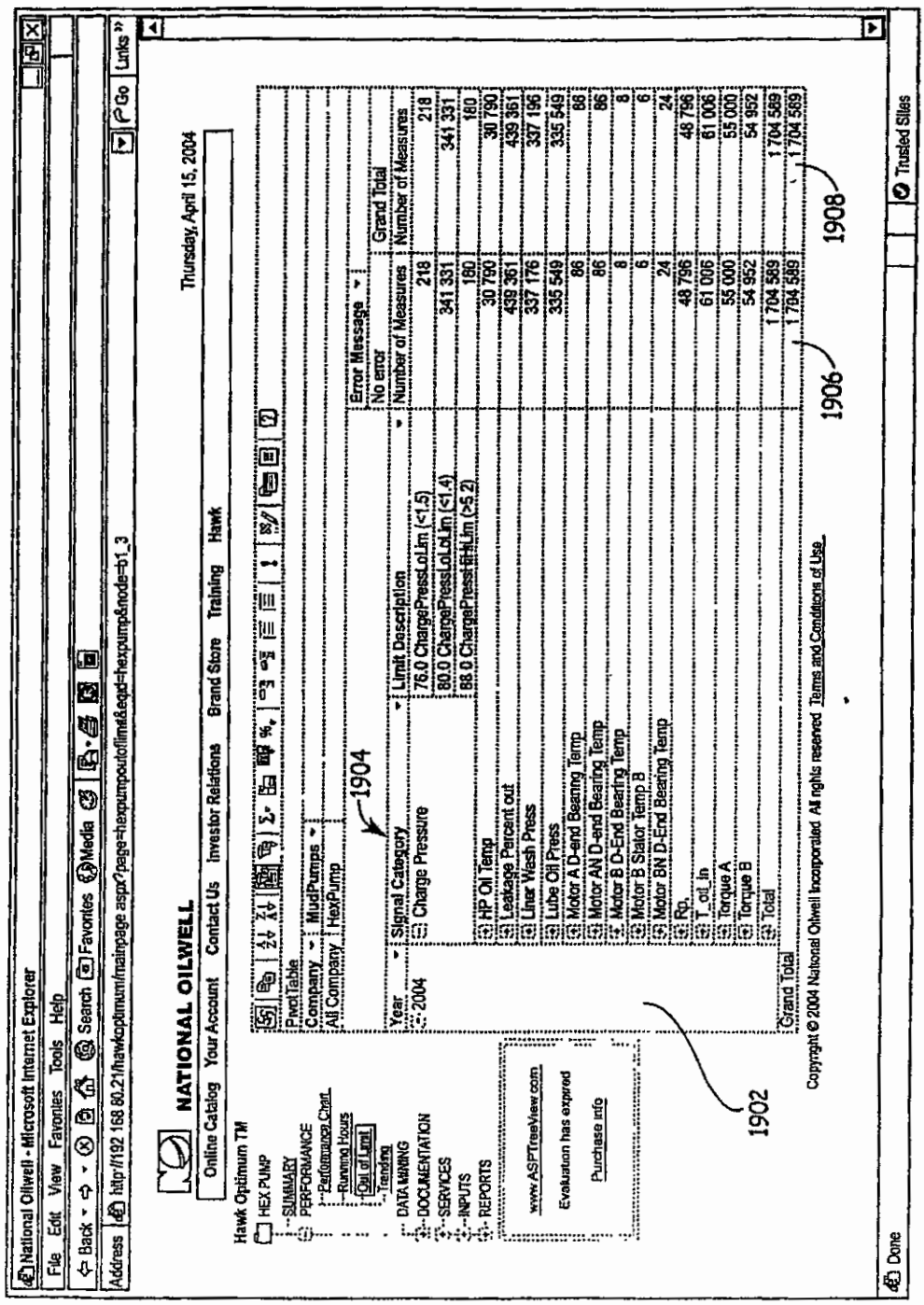

National Oilwell - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://192.168.80.21/hawkoptimum/mainpage.aspx?page=hexpumpoutoflimit&eqid=hexpump&node=b1_3
Links
NATIONAL OILWELL
Online Catalog Your Account Contact Us Investor Relations Brand Store Training Hawk
Thursday, April 15, 2004
Hawk Optimum TM
HEX PUMP
SUMMARY
PERFORMANCE
Performance Chart
Running Hours
Out of Limit
Trending
DATA MINING
DOCUMENTATION
SERVICES
INPUTS
REPORTS
PivotTable
Company MudPumps
All Company HexPump
1904
Error Message
No error
Year
Signal Category
Limit Description
Number of Measures
Grand Total
2004
Charge Pressure
76.0 ChargePressLoLim (<1.5)
80.0 ChargePressLoLim (<1.4)
88.0 ChargePressHiLim (>5.2)
HP Oil Temp
Leakage Percent out
Linar Wash Press
Lube Oil Press
Motor A D-end Bearing Temp
Motor AN D-end Bearing Temp
Motor B D-End Bearing Temp
Motor B Stator Temp B
Motor BN D-End Bearing Temp
Rp
T_oil_In
Torque A
Torque B
Total
Grand Total
www.ASPTreeView.com
Evaluation has expired
Purchase info
1902
1906
1908
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Done
Trusted Sites

FIG. 19

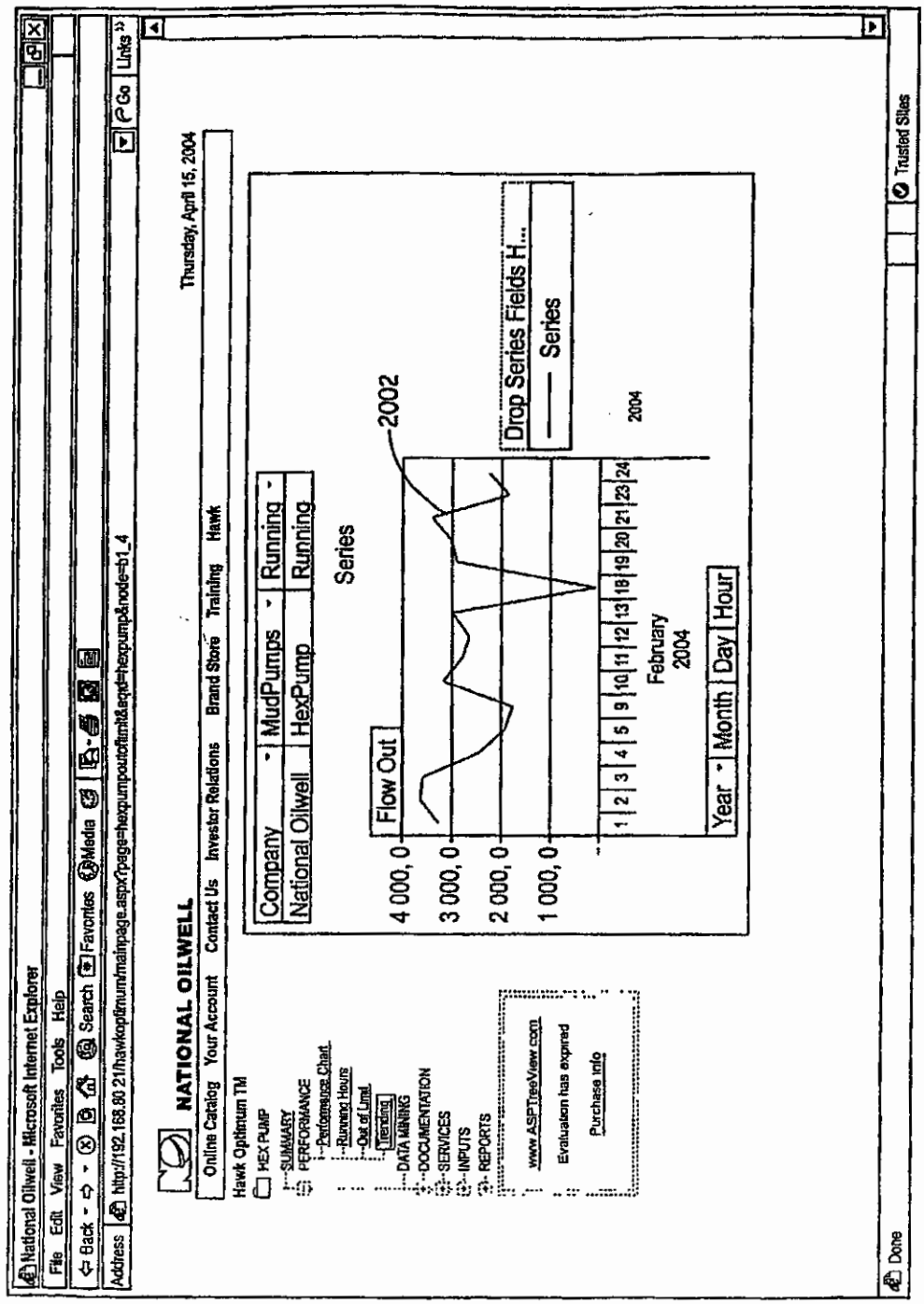

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Address http://192.168.80.21/hawkoptimum/mainpage.aspx?page=hexpumpoutoftimit&acpd=hexpump&node=b1_4
Links
NATIONAL OILWELL
Thursday, April 15, 2004
Online Catalog Your Account Contact Us Investor Relations Brand Store Training Hawk
Hawk Optimum TM
HEX PUMP
SUMMARY
PERFORMANCE
Performance Chart
Running Hours
Out of Limit
Trending
DATA MINING
DOCUMENTATION
SERVICES
INPUTS
REPORTS
www.ASPTreeView.com
Evaluation has expired
Purchase info
Company
MudPumps
Running
National Oilwell
HexPump
Running
Series
Flow Out
4 000, 0
3 000, 0
2 000, 0
1 000, 0
2002
Drop Series Fields H...
Series
1 2 3 4 5 6 9 10 11 12 13 18 19 20 21 23 24
February
2004
2004
Year
Month
Day
Hour
Done
Trusted Sites

FIG. 20

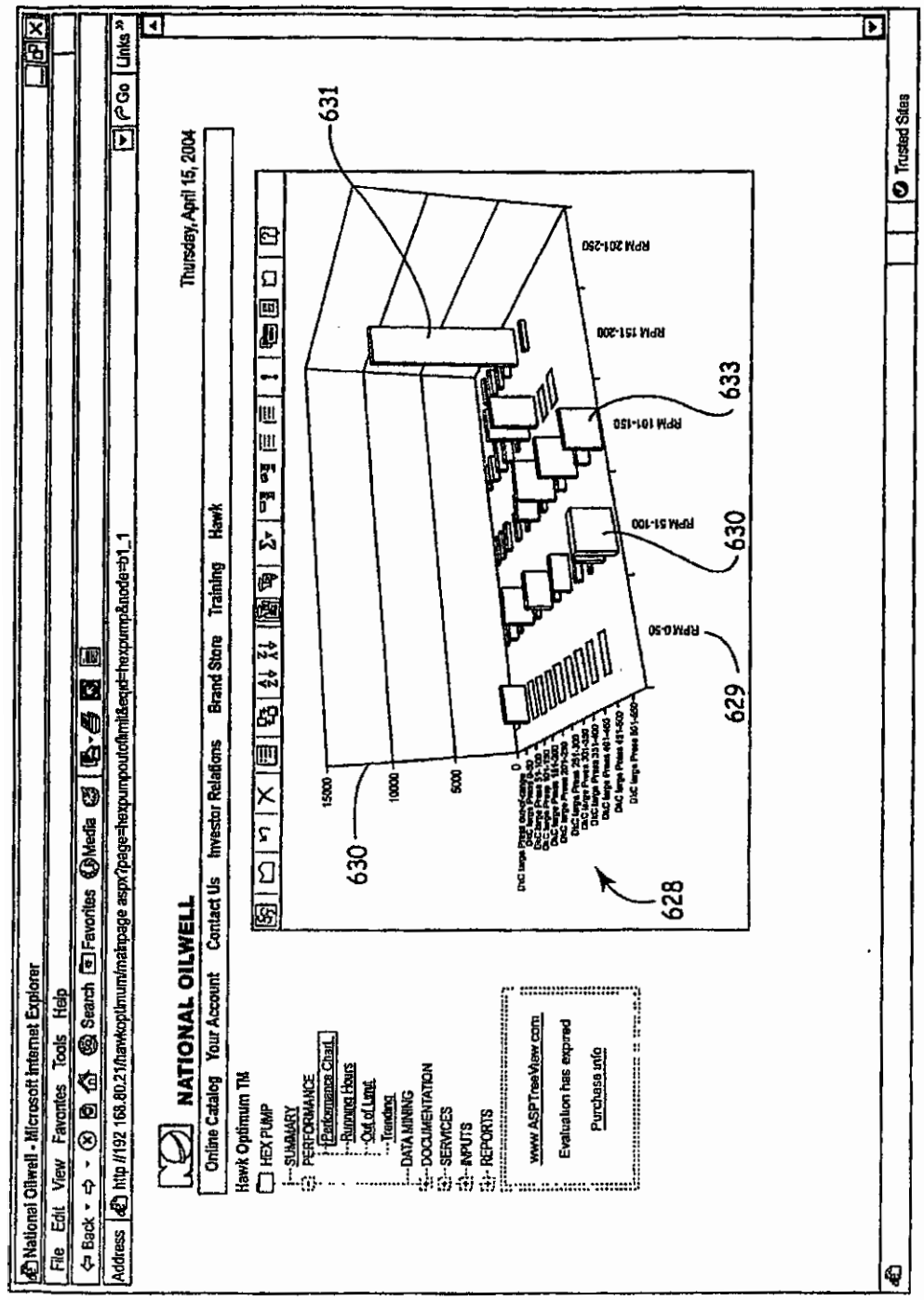

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Links
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Hawk Optimum TM
HEX PUMP
SUMMARY
PERFORMANCE
Performance Chart
Running Hours
Out of Limit
Trending
DATA MINING
DOCUMENTATION
SERVICES
INPUTS
REPORTS
www.ASPTreeView.com
Evaluation has expired
Purchase info
15000
10000
5000
0
RPM 201-250
RPM 151-200
RPM 101-150
RPM 51-100
RPM 0-50
631
630
633
630
629
628

FIG. 21

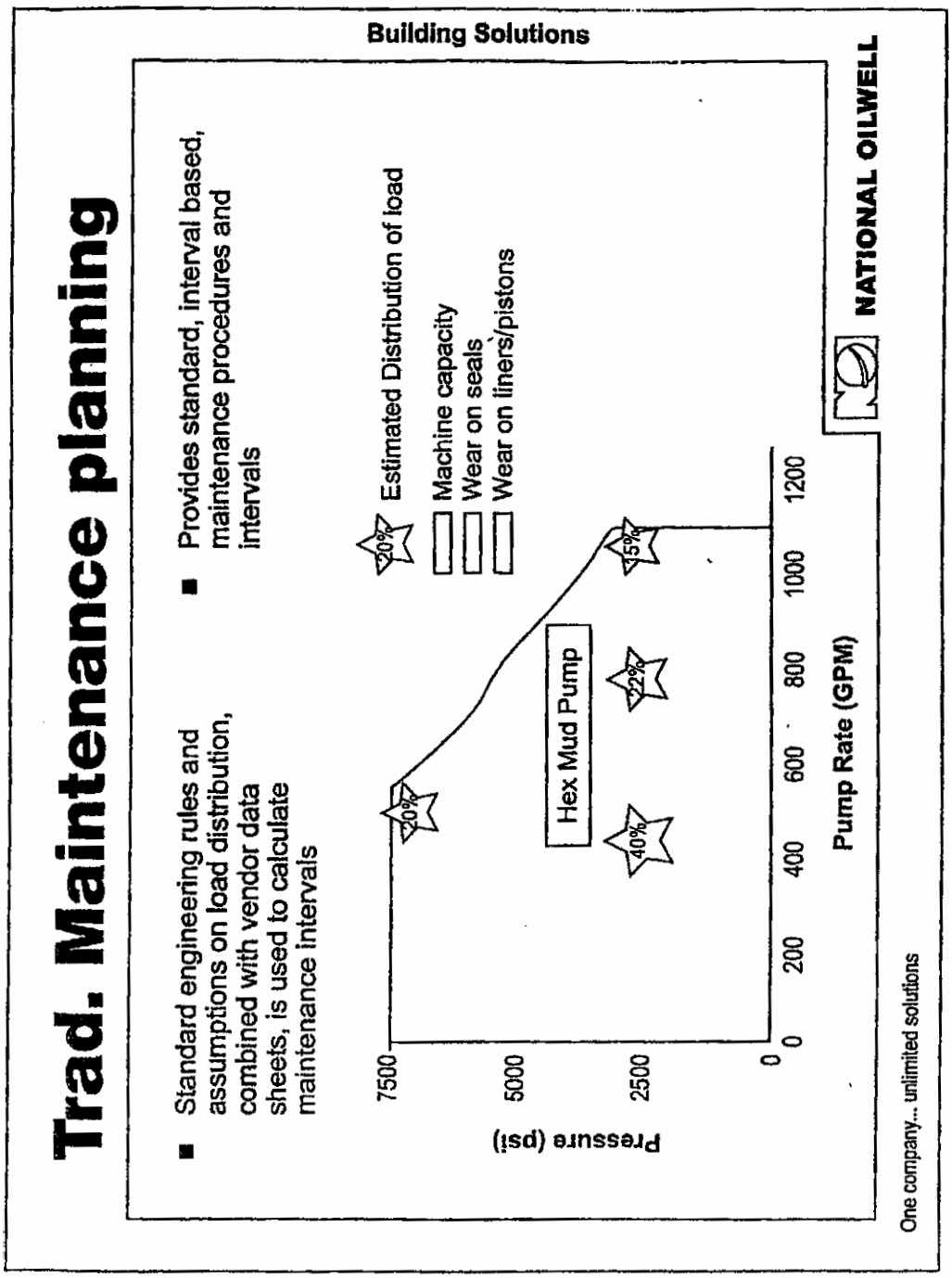

Trad. Maintenance planning
Building Solutions
Standard engineering rules and assumptions on load distribution, combined with vendor data sheets, is used to calculate maintenance intervals
Provides standard, interval based, maintenance procedures and intervals
Estimated Distribution of load
Machine capacity
Wear on seals
Wear on liners/pistons
Hex Mud Pump
20%
40%
22%
15%
Pressure (psi)
7500
5000
2500
0
0
200
400
600
800
1000
1200
Pump Rate (GPM)
NATIONAL OILWELL
One company... unlimited solutions

FIG. 22

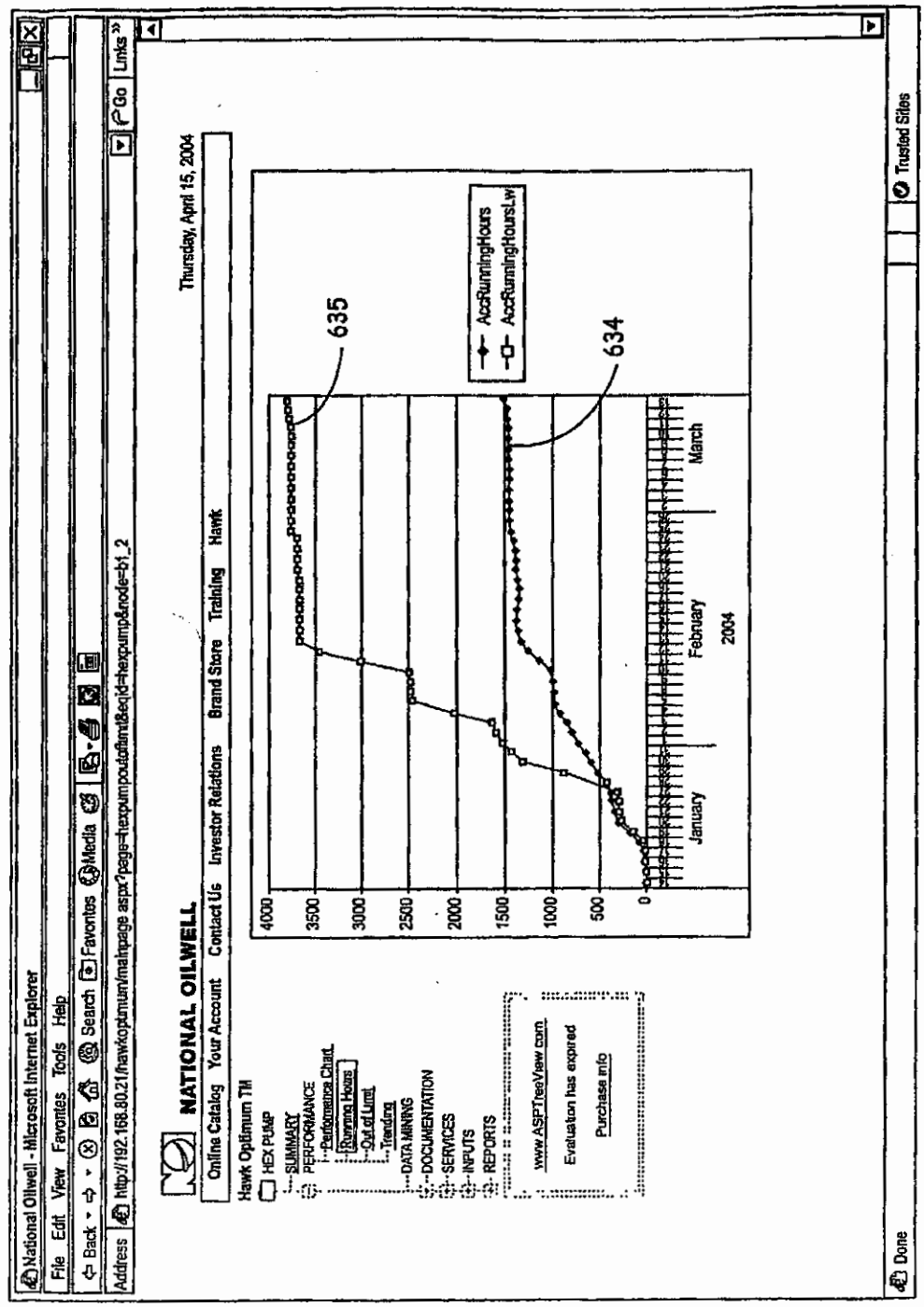

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Evaluation has expired
Purchase info
635
634
AccRunningHours
AccRunningHoursLw
4000
3500
3000
2500
2000
1500
1000
500
0
January
February
March
2004
Done
Trusted Sites

FIG. 23

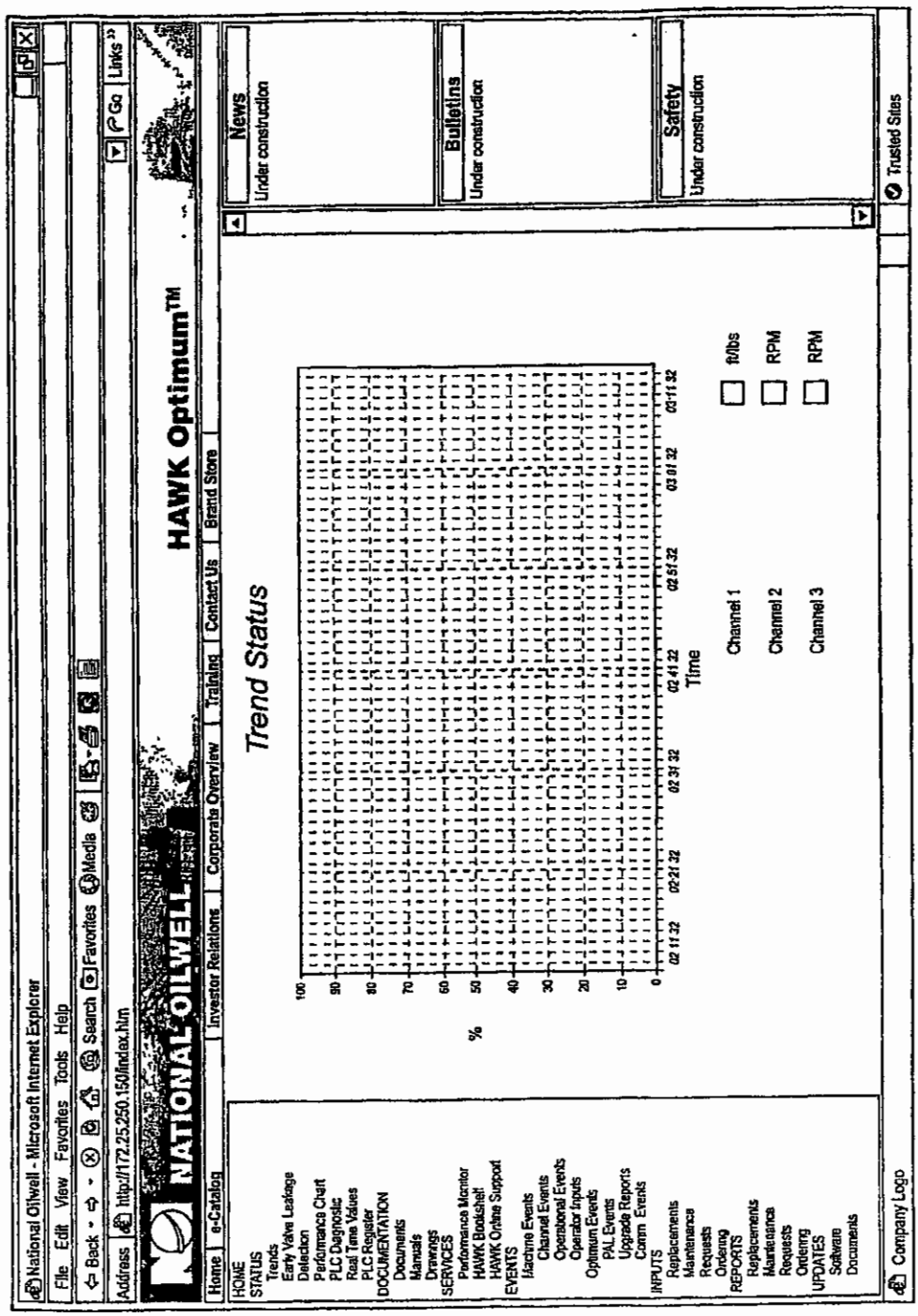

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Trends
Early Valve Leakage
Detection
Performance Chart
PLC Diagnostic
Real Time Values
PLC Register
DOCUMENTATION
Documents
Manuals
Drawings
SERVICES
Performance Monitor
HAWK Bookshelf
HAWK Online Support
EVENTS
Machine Events
Channel Events
Operational Events
Operator Inputs
Optimum Events
PAL Events
Upgrade Reports
Comm Events
INPUTS
Replacements
Maintenance
Requests
Ordering
REPORTS
Replacements
Maintenance
Requests
Ordering
UPDATES
Software
Documents
Trend Status
%
Time
Channel 1
Channel 2
Channel 3
ft/lbs
RPM
RPM
News
Under construction
Bulletins
Under construction
Safety
Under construction
Company Logo
Trusted Sites

FIG. 24

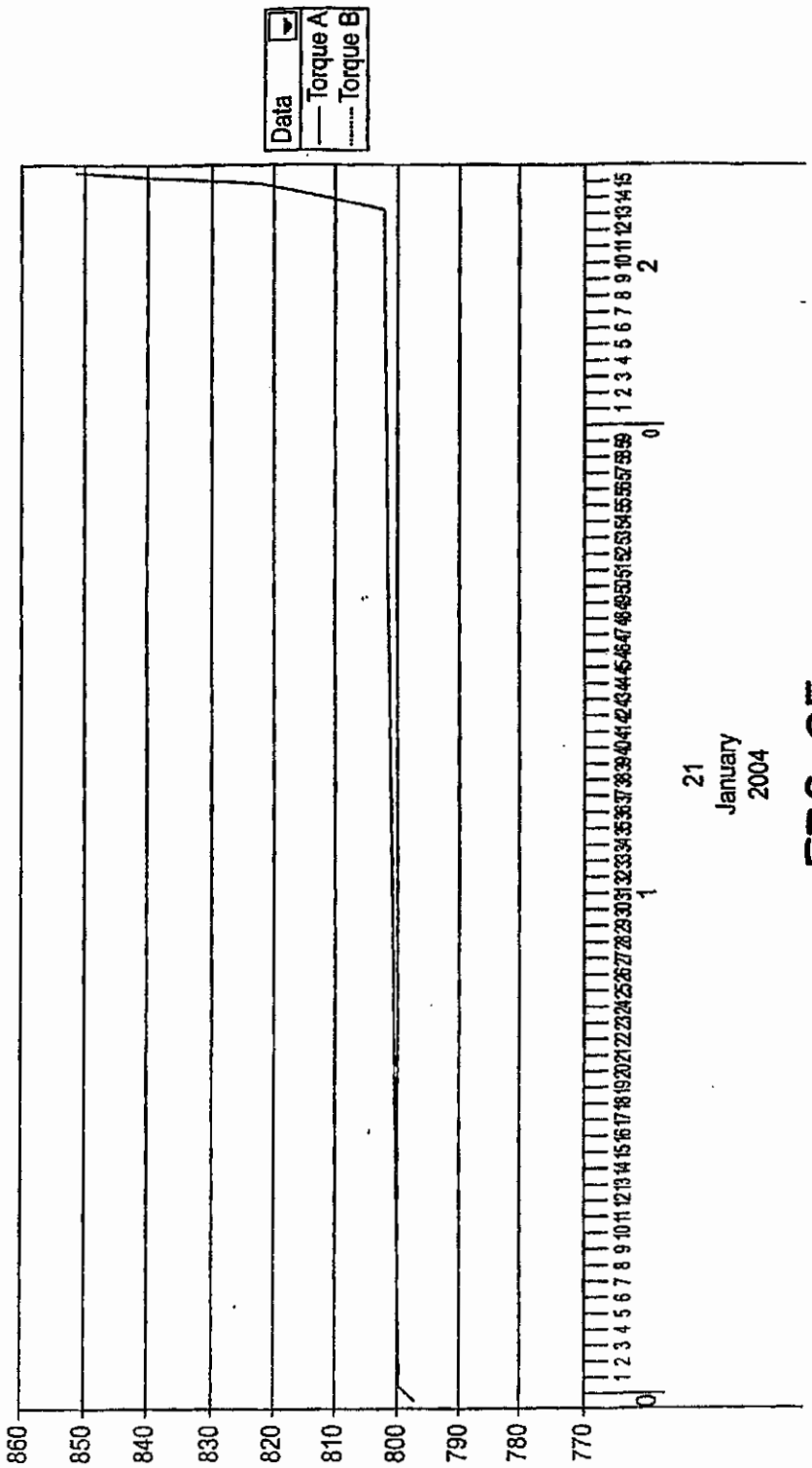

Data
Torque A
Torque B
860
850
840
830
820
810
800
790
780
770
21
January
2004

FIG. 25

2D Performance Limits

Equipment ID	Signal Category ID	Configuration ID	Dim1	Dim2	Value
4	38	1	8.1	0	15
4	38	1	8.1	0.5	15
4	38	1	8.1	1	15
4	38	1	8.1	1.5	15
4	38	1	8.1	2	15
4	38	1	8.1	2.5	0
4	38	1	10	0	15
4	38	1	10	0.5	15
4	38	1	10	1	15
4	38	1	10	1.5	15
4	38	1	10	2	15
4	38	1	10	2.5	0
4	38	1	15	0	15
4	38	1	15	0.5	15
4	38	1	15	1	15
4	38	1	15	1.5	15
4	38	1	15	2	15
4	38	1	15	2.5	0
4	38	1	20	0	15
4	38	1	20	0.5	15
4	38	1	20	1	15
4	38	1	20	1.5	15
4	38	1	20	2	15
4	38	1	20	2.5	0

FIG. 26