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Status rapport

instrumentering af Wave Dragon, Nissum Bredning

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Publication date:
2003

Document Version
Også kaldet Forlagets PDF

Link to publication from Aalborg University

Citation for published version (APA):
Kofoed, J. P. (2003). *Status rapport: instrumentering af Wave Dragon, Nissum Bredning*. Fagruppen for Hydraulik og Havnebygning, Instituttet for Vand, Jord og Miljøteknik, Aalborg Universitet.

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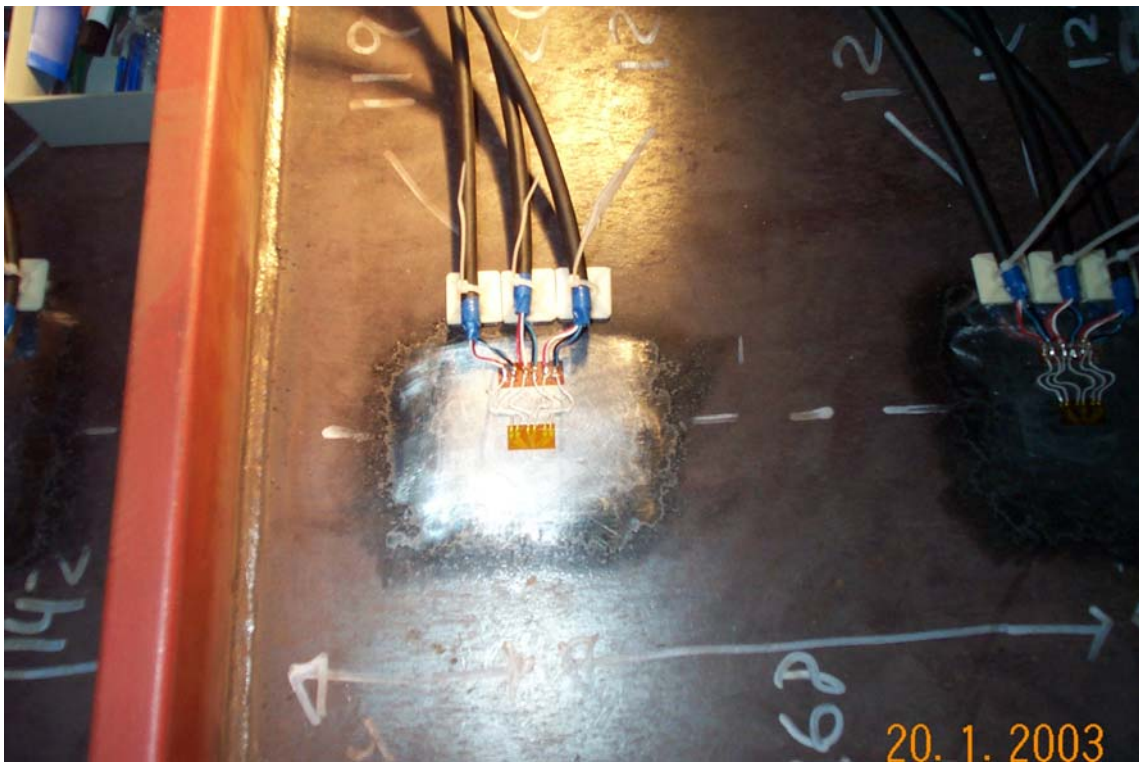
Statusrapport
–
Instrumentering af Wave Dragon, Nissum Bredning



Projekt:

Bestemmelse af hydraulisk respons af bølgeenergiomsætteren Wave Dragon

iht. Samarbejdsaftale mellem
Wave Dragon Test Aps.
og
Aalborg Universitet, Institut for Vand, Jord og Miljøteknik.

Jens Peter Kofoed
Maj, 2003

Faggruppen for Hydraulik og Havnebygning
Instituttet for Vand, Jord og Miljøteknik - Sohngaardsholmsvej 57 - 9000 Aalborg - Telefon 9635 8080

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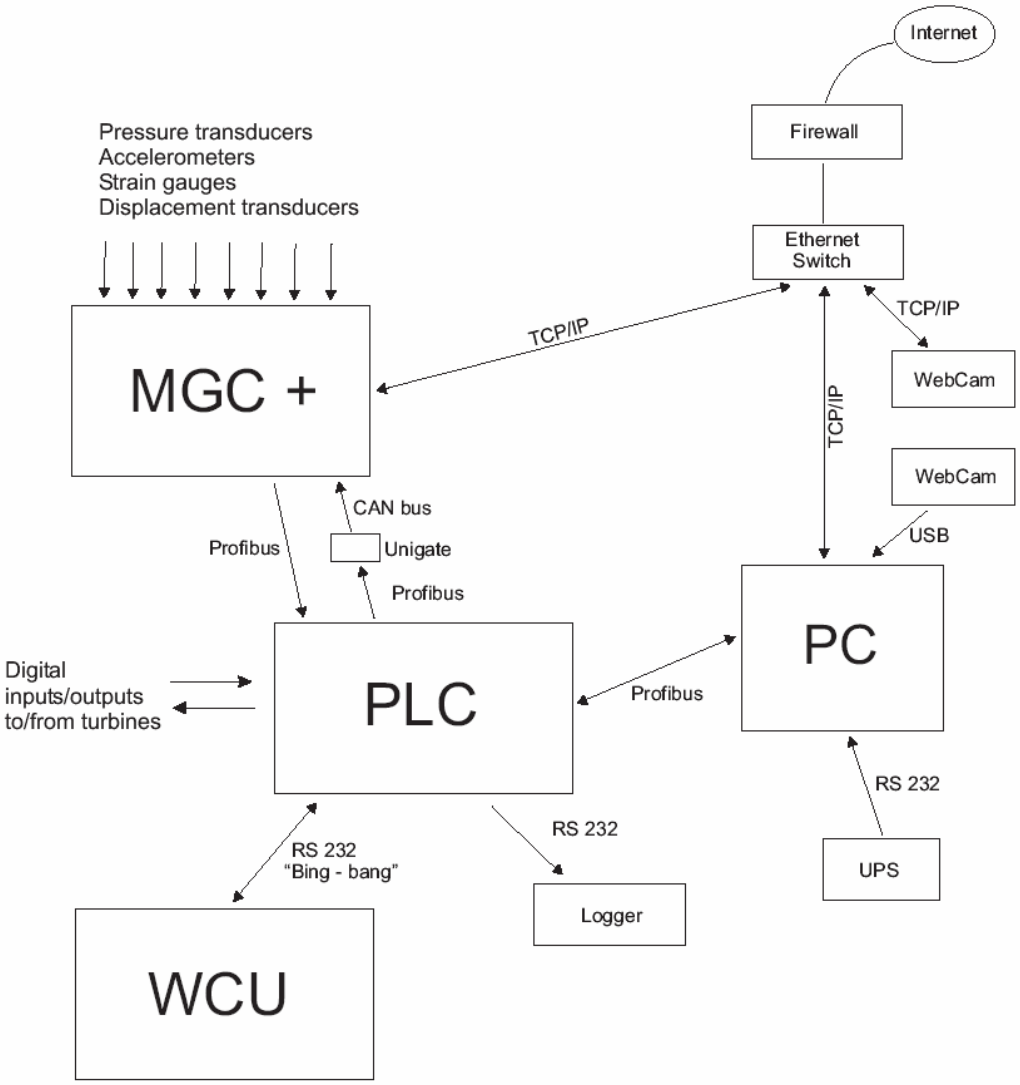
Indledning

Nærværende statusrapport beskriver i ord og billeder instrumenteringen af Wave Dragon, Nissum Bredning modellen (WD-NB). Instrumenteringen beskrevet i denne rapport er primært sket under konstruktionen af anlægget.

Siden projektets opstart er der løbende blevet publiceret materiale i form af billeder, video, notater og rapporter på websiden http://www.civil.auc.dk/~i5jpk/wd/wdnb.htm .

Måle- og reguleringssystem

Den principielle udformning af måle og reguleringssystemet ombord på WD er beskrevet i Appendix A. Systemet er løbende blevet tilrettet og justeret. Nedenstående diagram præsenterer status af systemets udformning.



Systemet tilpasses løbende.

Forbindelsen til WD via internettet udføres iht. Appendix C.

Instrumenter

WD udrustes med en række forskellige måleinstrumenter, således som det fremgår af appendix A.

I det følgende beskrives de enkelte komponenter i ord og billeder fra installationen.

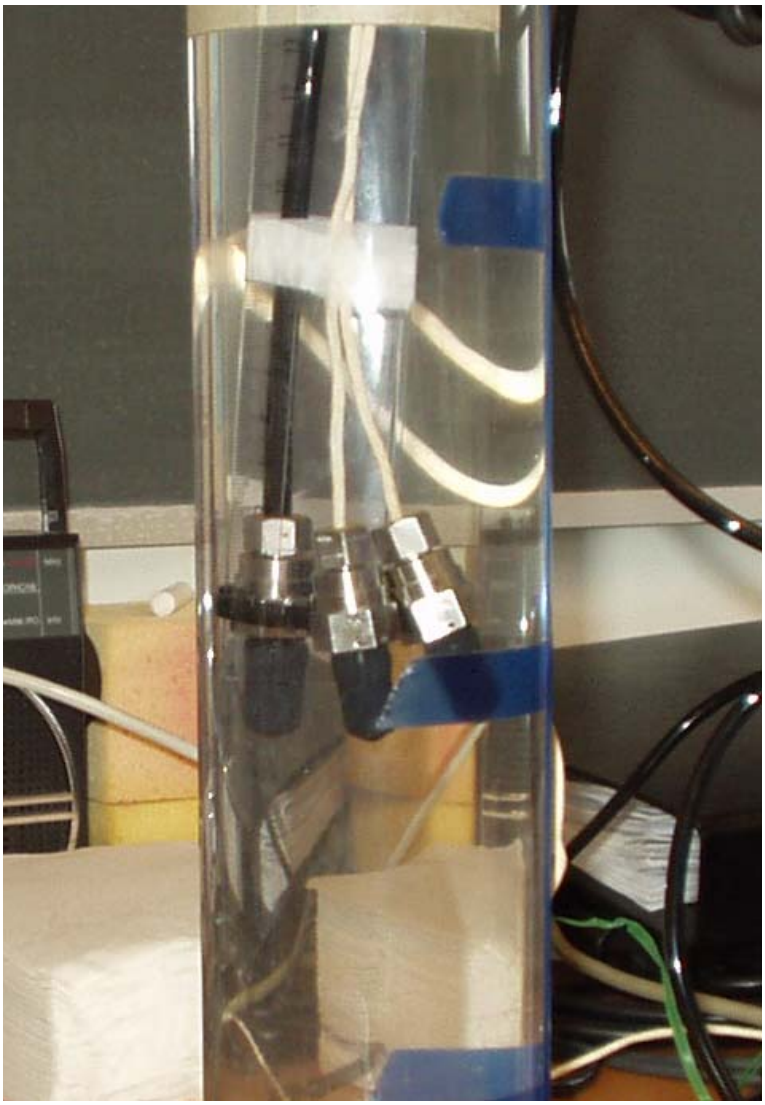
Tryktransducere

Markering af placering af tryktransducer (PRES_AC3 og PRES_R3).

Muffe til iskruning af tryktransducer.

Stander til junction box, hvori kabler fra de enkelte transducere samles med multikabler, der føre signalerne til målecontainer.

Afprøvning af tryktransducere inden montering.



Monteret tryktransducer. Transduceren er monteret i et specialfremstillet beskyttende hus.

Monteret tryktransducer, set fra den trykfølsomme side.

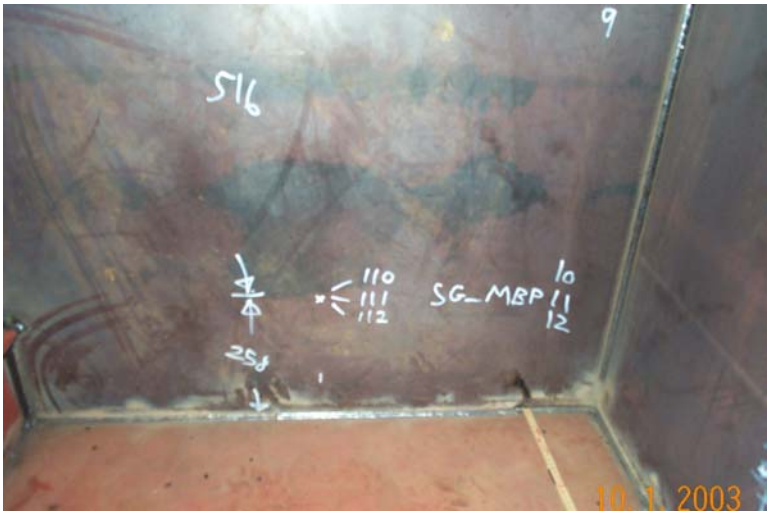
Kabler fra transducer og multikabler samles i junction box.

Tryktransducer, samt vandtæt ledningsgennemføring i reservoirdæk.

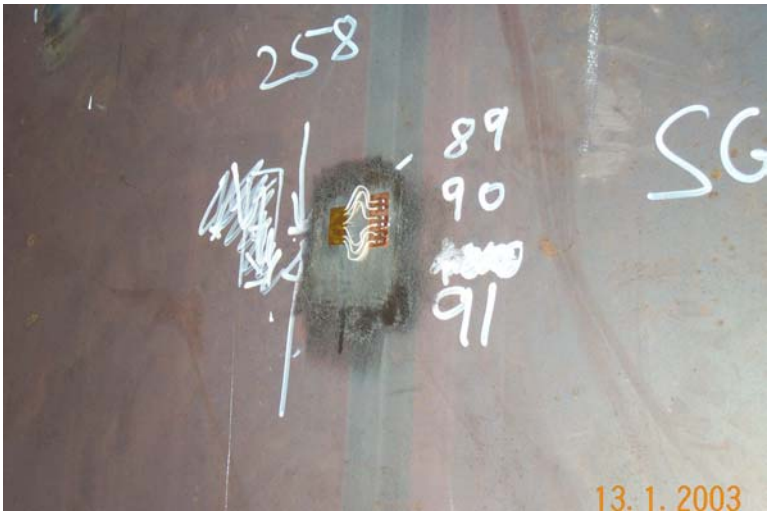
Tryktransducer placeret på pæl på hovedforankringsbøtte, anvendes til måling af bølger.

Strain gauges

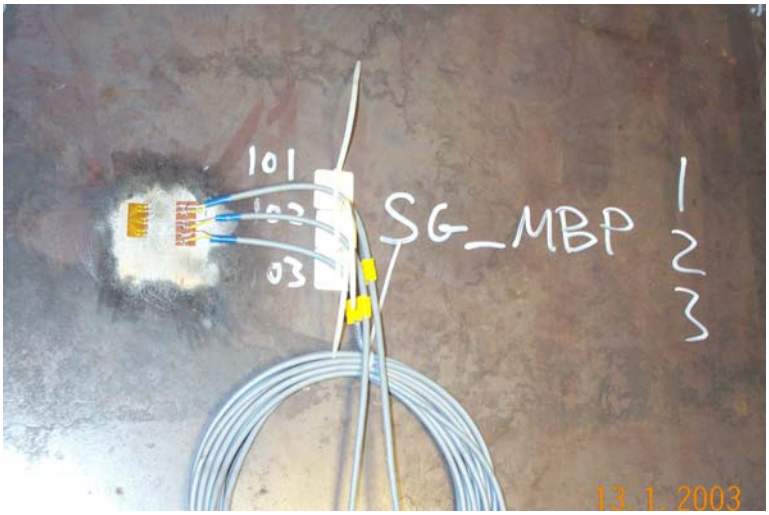
Opmærkning af placering af strain gauges (SG_MBP10-12).



Strain gauges (en rosette gauge bestående af 3 individuelle gauges) monteret, inden påsætning af kabler og og tætningsmaterialer.

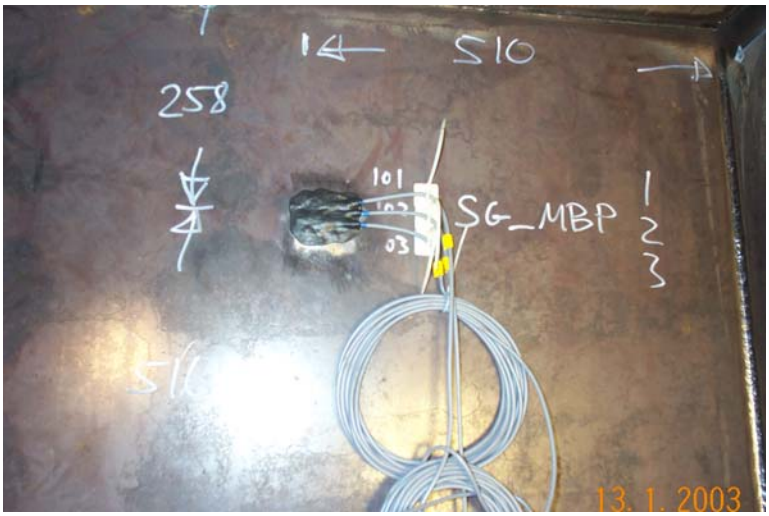


Kabler monteret på loddeterminal.

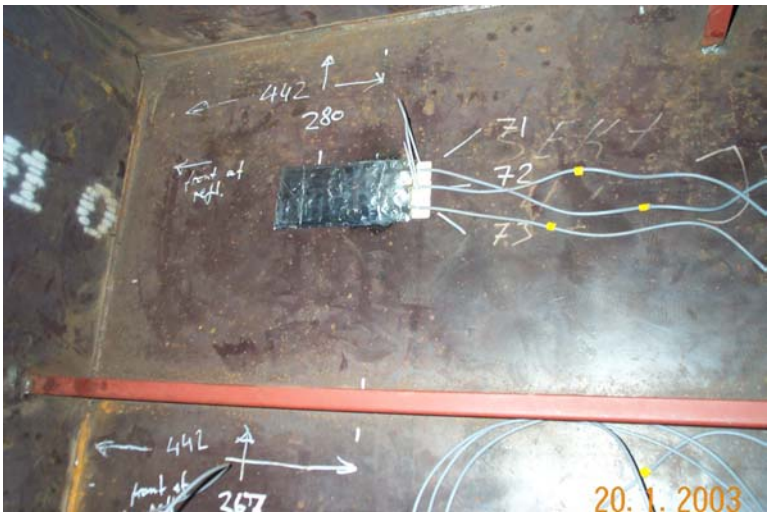


Strain gauges i hovedbjælken (i midten af platformen) inden tætning.

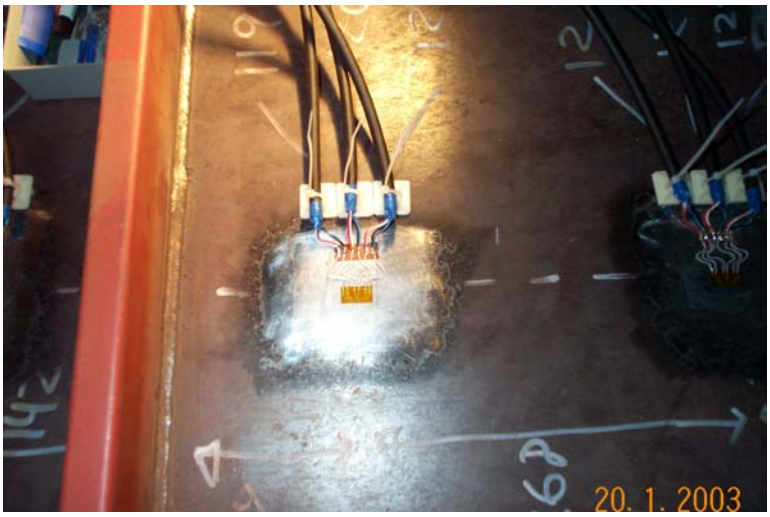
Tætning af selve rosette gaugen.



Rosette og loddeterminal tætnet.

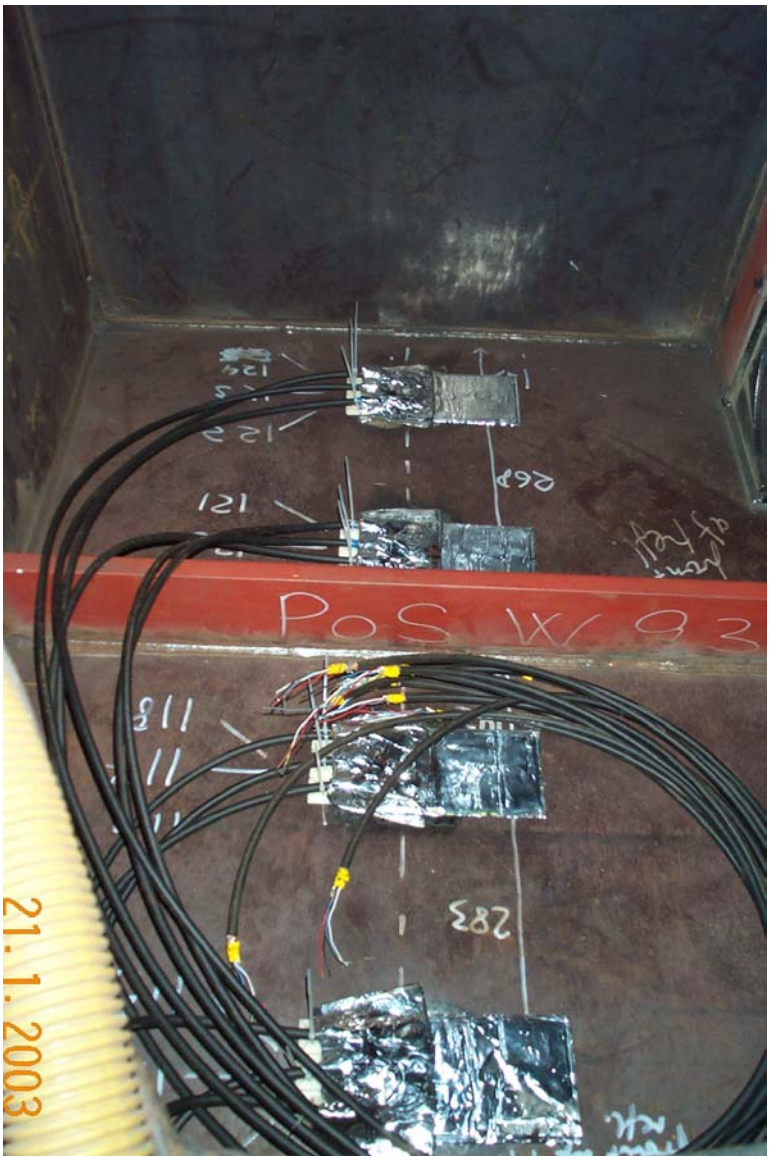


Rosette gauge i vandfyldt kammer. Her anvendes særlige vandbestandige siliconekabler.



Montagesituation.

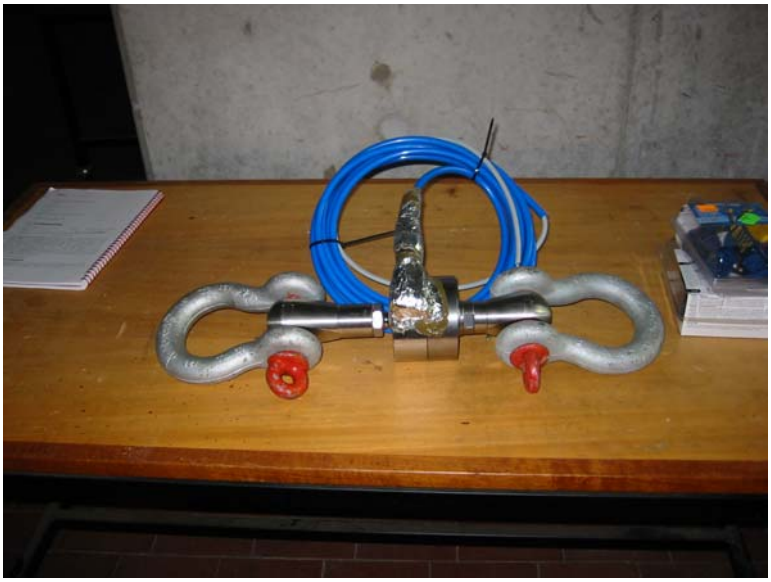
Færdigmonterede gauges i vandfyldt kammer.



Krafttransducere

Krafttransducer (100 kN) til måling af hovedforankringskraft, monteret på forankringsbøtte.

Krafttransducer (50 kN) til måling af kræfter i tværwire imellem reflektorer.

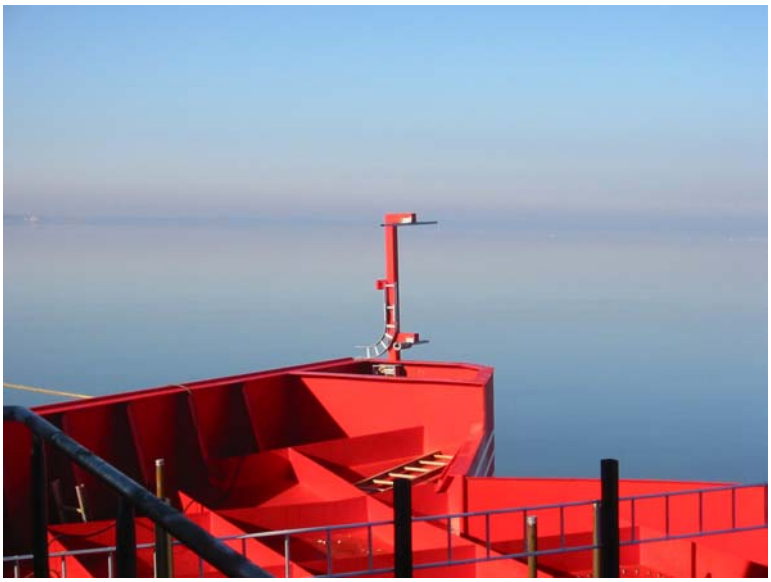


Flytningstransducere

Der monteres flytningstransducere i skulder forbindelsen mellem platform og den ene reflektor mhp. måling af deformation af fenderarrangementet i dette led.

Pæl til fastgørelse af den ene ende (reflektor) af flytningstranducer.

Pæl til fastgørelse af den anden ende (platform) af flytningstranducer. Disse pæle anvendes også til overførelse af multikabler fra reflektor til platform.



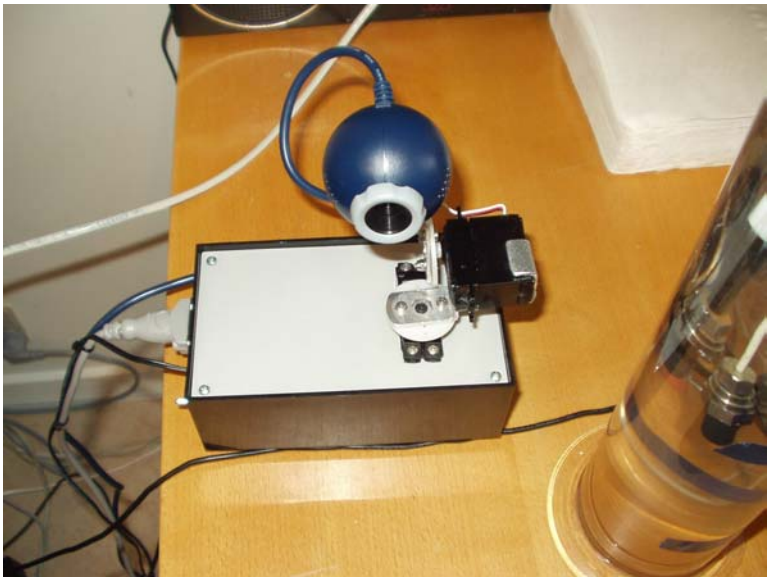
Accelerometre

Der monteres accelerometre på platform og arme til bestemmelse af disses bevægelser. På platformen placeres hhv. et vandret og et lodret i målecontaineren, samt et lodret på hver skylder. På den ene reflektor placeres et vandret og et lodret.

Pæl til montering af accelerometre på bagbord reflektor.

WebCam

WebCam med pan og tilt styring.



Appendix

Appendix A: Setup of measuring and control system for Wave Dragon, Nissum Bredning model, DEA + EU project.

Appendix B: Details for installation of transducers and description of interfaces.

Appendix C: Funktionskrav til netværk og internetforbindelse på WD-NS.

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Setup of measuring and control system for Wave Dragon, Nissum Bredning model, DEA + EU project

Introduction:

This note describes the measuring and control system to be installed on the Nissum Bredning model of the Wave Dragon within the DEA and EU project, 2002 – 2004.

In the following pages the following is found:

- A diagram sketching the layout of the system.
- A table listing the components in the data acquisition (DAQ) part of the system.
- Drawings indicating the approximate placement of the measuring devices listed in the table.

As it can be seen from the diagram the system consists of the following main parts:

1. A number of sensors connected to a DAQ unit, (HBM MGC+).
2. A PC.
3. A PLC unit for controlling the generator/turbine.
4. A PLC unit for controlling the floating level of the platform.

A short description of each part is given below.

1. Sensors and HBM MGC+:

The main component in this part of the system is the HBM MGC+. The MGC+ includes strain gauge amplifiers for the pressure transducers, force transducers and strain gauges, and analogue-digital converters (ADCs), lowpass filters, etc. 12 x 8 channels strain gauges amplifiers, and corresponding ADCs, are included as well as additional 2 x 8 channels ADC units for displacement transducers, registration of turbine speed, generator power production, accelerations, wind speed and direction. In the MGC+ system there is room for additional 2 units, which can be e.g. a PLC unit and an analogue or digital output card. Furthermore, if needed the system can be expanded with another (or more) MGC+ boxes.

The data acquired by the MGC+ can be stored on hard disks in the MGC+ it self and/or send to PC and PLCs by ethernet, RS-232, CAN-bus and/or Profibus. Using CAN-bus and/or Profibus requires a separate card in the MGC+.

The sensors can be divided in to five groups:

a. Pressure cells under platforms.
b. Pressure cell on pile.

c. Pressure cells in reservoir.
d. Pressure cells in air chambers.
e. Accelerometers.
f. Force transducers.
g. Displacement transducers.
h. Wind speed and direction measuring system.
i. Turbine speed and power generation.

ad. a. The pressure cells under the platform are used for determining the crest freeboard and to check that the platform is in level.

ad. b. The pressure cell on the mooring pile is used for wave measurements.

ad. c. The pressure cells in the reservoir are use for determining the water level in the reservoir.

ad. d. The pressure cells in the air chambers are used for the regulation of the floating level of the platform.

ad. e. The accelerometers are used for determining the movements of the platform and reflector. The heave, pitch, surge and roll movements of the platform can be determined by the four accelerators on the platform. As the reflector is restraint against heave, surge, sway and yaw at the shoulder by the connection to the platform, the movements of the reflector can be determined by the two accelerometers on it.

ad. f. The force transducers are located at the pile in the main mooring cable and in the cross cable between the reflectors. A slack security wire bypassing the force gauges should be used in order to ensure that a failure of one of the force gauge does not break the mooring lines.

ad. g. Displacement sensors are used for registration of the relative movement between the platform and the starboard reflector. This enables an estimation of the forces in the shoulder connection by use of the properties of the used fenders.

ad. h. The wind speed and direction measuring system can be used for estimation of the wave climate by hindcasting.

ad. i. Data from the 7 turbines/generators are given in form of turbine speed and power generation. From these data and characteristics of generators and turbines the flow can be calculated. It is assumed that the data from turbines/generators are supplied as analogue signals (up to +/- 10V).

2. PC:

The PC is used for storing the data acquired by the MGC+ either online, or by emptying the MGC+ occasionally. The stored data is processed and key parameters are calculated and can be distributed via DSL connection to the project website.

The PC is also used for programming the PLCs for controlling the generator/turbine and the floating level of the platform.

Note on PLC:

It is possible to include a PLC in the MGC+ system. If this is chosen the MGC+ system will also be equipped with analogue and digital outputs to supply signals to generators and valves to the air

chambers, siphon, and cylinder gates. The PLC-unit for the MGC+ system can be programmed using the software package CoDeSys (see www.codesys.de). CoDeSys is capable of importing PLC programs developed using Siemens Step 7, though some adjustments might be necessary.

3. PLC turbine:

The PLC unit for controlling the generators/turbines is regulating the generators/turbines speed as outlined below.

Based on the measurements of pressures under the platform and the pressures in the reservoir near the turbine, the turbine head is calculated and the corresponding optimal turbine speed is found from the turbine characteristics ($n = K\ \mathrm{sqrt}(H)$), where n is turbine speed, K is a characteristic constant for the turbine and H is the head). The PLC then controls the generator so this speed is obtained.

Furthermore, the siphon and cylinder gates are operated by the PLC based on the water level in the reservoir according to the selected (programmed) strategy.

Outline of first simple procedures to be used in PLC turbine controller:
(Underscored numbers are variables to be changed.)

Floating level:

Sample frequency: 1 Hz.

```
Check p1, p2, p3, p4 are reasonable (in the range 0 and 2 m XXor otherXX)
Moving average of 60 samples stored in p1_m_ave, p2_m_ave, p3_m_ave, p4_m_ave.
Floating level calculated as:
float_level:=vert_dist_crest_PT_under_platform - sum(p1_m_ave, p2_m_ave, p3_m_ave, p4_m_ave)/4
```

Water level in reservoir:

Sample frequency: 1 Hz.

```
Check p5, p6, p7 are reasonable (in the range 0 and 1 m XXor otherXX)
Moving average of 15 samples stored in p5_m_ave, p6_m_ave, p7_m_ave.
Floating level calculated as:
res_water_level:=vert_dist_crest_PT_in_reservoir - sum(p1_m_ave, p2_m_ave, p3_m_ave)/3
```

Target turbine speed:

Sample frequency: 1 Hz.

```
Turbine head calculated as:
turbine_head:= vert_dist_crest_PT_in_reservoir - vert_dist_crest_PT_under_platform;
Target turbine speed calculated as:
target_turbine_speed:=K sqrt(turbine_head)
```

Control siphon:

Sample frequency: 1 Hz.

```
if time - stop_time > 15 then
  if res_water_level < 0.2 then startup_siphon and set startup_time
if time - startup_time > 15 then
  if res_water_level > 0.5 then stop_siphon and set stop_time
```

4. PLC level:

The PLC unit for controlling the floating level of the platform is regulating the floating level of the platform. The procedure for performing this regulation is outlined in Hald and Friis-Madsen (2001).

In addition to the procedure describe by Hald and Friis-Madsen (2001) a sub routine is implemented for regulating the distribution of air to the air chambers, not only so the correct crest freeboard is obtained, but also for ensuring that the platform is floating horizontally.

Outline of first simple procedures to be used in PLC level controller:
(Underscored numbers are variables to be changed.)

Floating level:

Sample frequency: 1 Hz.

```
Check p1, p2, p3, p4 are reasonable (in the range 0 and 2 m XXor otherXX)
Moving average of 60 samples stored in p1_m_ave, p2_m_ave, p3_m_ave, p4_m_ave.
Floating level calculated as:
float_level:=vert_dist_crest_PT_under_platform - sum(p1_m_ave, p2_m_ave, p3_m_ave, p4_m_ave)/4
```

Significant wave height from pressure transducer at pile:

Sample frequency: 5 Hz.

```
Moving average of 9000 samples stored in p8_m_st_dev.
Significant wave height calculated as:
sig_wave_height_PT:=4*p8_m_st_dev
```

Target floating level:

```
Calculated every 30 min.
target_float_level:=f(sig_wave_height_PT) (f is a simple function as 0.7 * sig_wave_height_PT)
if target_float_level < 0.1 then target_float_level:=0.1
if target_float_level > 1 then target_float_level:=1
```

Controling floating level:

```
Performe every 5 min.
p9_before:=p9
p10_before:=p10
p11_before:=p11
p12_before:=p12
p13_before:=p13
float_level_before:=float_level
p9_target:=p9_before+0.9*(float_level_target-float_level_before)
p10_target:=p10_before+0.9*(float_level_target-float_level_before)
p11_target:=p11_before+0.9*(float_level_target-float_level_before)
p12_target:=p12_before+0.9*(float_level_target-float_level_before)
p13_target:=p13_before+0.9*(float_level_target-float_level_before)
start blower
if p9 > p9_target then open output_valve_chamber_1 until abs(p9_target-p9) < 0.02
if p9 < p9_target then open input_valve_chamber_1 until abs(p9_target-p9) < 0.02
if p10 > p10_target then open output_valve_chamber_2 until abs(p10_target-p10) < 0.02
if p10 < p10_target then open input_valve_chamber_2 until abs(p10_target-p10) < 0.02
if p11 > p11_target then open output_valve_chamber_3 until abs(p11_target-p11) < 0.02
if p11 < p11_target then open input_valve_chamber_3 until abs(p11_target-p11) < 0.02
if p12 > p12_target then open output_valve_chamber_4 until abs(p12_target-p12) < 0.02
if p12 < p12_target then open input_valve_chamber_4 until abs(p12_target-p12) < 0.02
if p13 > p13_target then open output_valve_chamber_5 until abs(p13_target-p13) < 0.02
if p13 < p13_target then open input_valve_chamber_5 until abs(p13_target-p13) < 0.02
stop blower
```

Heeling, pitch:

```
Heeling, pitch, calculated as:
heel_pitch:=(p1_m_ave-0.5*(p3_m_ave+p4_m_ave))/hor_dist_PT1_PT3and4
```

Heeling, roll:

```
Heeling, roll, calculated as:
heel_roll:=p3_m_ave-p4_m_ave)/hor_dist_PT3_PT4
```

Controling heeling, pitch:

```
Performe every 5 min.
p9_before:=p9
p11_before:=p11
heel_pitch_before:=heel_pitch
p9_target:=p9_before+0.4*heel_pitch_before*hor_dist_PT1_PT3and4
if p9_target < 0.2 then p9_target:=0.2
if p9_target > 0.8 then p9_target:=0.8
p11_target:=p11_before-0.4*heel_pitch_before*hor_dist_PT1_PT3and4
if p11_target < 0.2 then p11_target:=0.2
if p11_target > 0.8 then p11_target:=0.8
start blower
if p9 > p9_target then open output_valve_chamber_1 until abs(p9_target-p9) < 0.02
if p9 < p9_target then open input_valve_chamber_1 until abs(p9_target-p9) < 0.02
if p11 > p11_target then open output_valve_chamber_3 until abs(p11_target-p11) < 0.02
if p11 < p11_target then open input_valve_chamber_3 until abs(p11_target-p11) < 0.02
stop blower
```

Controling heeling, roll:

```
Performe every 5 min.
p12_before:=p12
p13_before:=p13
heel_roll_before:=heel_roll
p12_target:=p12_before+0.4*heel_roll_before*hor_dist_PT3_PT4
if p12_target < 0.2 then p12_target:=0.2
if p12_target > 0.8 then p12_target:=0.8
p13_target:=p13_before-0.4*heel_roll_before*hor_dist_PT3_PT4
if p13_target < 0.2 then p13_target:=0.2
if p13_target > 0.8 then p13_target:=0.8
start blower
if p12 > p12_target then open output_valve_chamber_4 until abs(p12_target-p12) < 0.02
if p12 < p12_target then open input_valve_chamber_4 until abs(p12_target-p12) < 0.02
if p13 > p13_target then open output_valve_chamber_5 until abs(p13_target-p13) < 0.02
if p13 < p13_target then open input_valve_chamber_5 until abs(p13_target-p13) < 0.02
stop blower
```

Other issues:

Error handling:
Is there any error messages or other condition parameters from generators (or other devices) that should be recorded in the MGC+ system?

A camera is to be installed on top of the control room. It will be connected to the PC.

Cabling, penetration of deck:

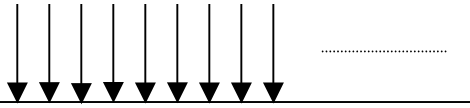
- The cables for the pressure cells under the platform (sensor 1 - 4) need holes through the deck. Holes should be placed so the connection between wire from transducer and the installation cable can be placed above a level where permanent water occurs, keeping in mind that the length of the wire on each transducer is 8 m.
- The cable for the pressure cell (sensor 8) at the pile follows the back wall to the shoulder and then has to pass the shoulder junction. On the reflector the cables can follow the screen to the cross wire is connected to the reflector. From the reflector to the pile it follows the slack oblique mooring cable to the pile. No deck penetration necessary.
- The cables for the pressure cells in the reservoir (sensor 5 - 7) can follow the catwalk to the turbine area. No deck penetration necessary.

- The cables for pressure transducers for air chambers, sensor 9 – 11 can mainly follow the turbine catwalk. Cables for sensor 12 – 13 can follow the back wall. The cables does not need to penetrate the deck, as the pressure cells have treads and can be mounted directly in a threaded hole in the deck, as sketched on drawing of placement of pressure transducers, air chambers.
- The cables for accelerometers 17 – 18 is inside the control room. For accelerometers 19 – 20 on the shoulders the cables can follow the back wall (partly shared with sensor 12 - 13). Also the cables for accelerometers 21 – 22 follows the back wall to the shoulders and then have to pass the shoulder junction. On the reflector the cables can follow the screen. No deck penetration necessary.
- The cables for the force transducers (sensor 23 - 24) follows the same path as back wall to the shoulders and then have to pass the shoulder junction. On the reflector the cables can follow the screen. For sensor 23 the cable follows the slack oblique mooring cable to the pile. No deck penetration necessary.
- The cables for the displacement sensors (sensor 33 - 36) follow the back wall to the shoulder. No deck penetration necessary.
- The cables for the strain gauges (sensor 41 – 64) the cables follow the back wall to the shoulder. At the shoulder a hole in the deck is needed, as these sensors are placed inside the structure. For sensor 77 – 88, 65 – 76 and 113 – 124 the cables are extended to pass the shoulder junction and follow the screen on the reflector to the placement where a hole is needed, as these sensors are placed inside the structure. For sensor 89 – 112 the cables can follow the catwalk to the turbine area where a hole in the deck is needed to get the cables inside the central beam.

Literature

Hald, T. and Friis-Madsen, E: *Strategy for regulating the crest freeboard of a floating wave energy converter*. Proc. Int. conf. on Marine Renewable Energies (MAREC 2001), Newcastle, 2001.

8 pressure cells, salt water (channel 1 – 8)
5 pressure cells, air (channel 9 – 13)
6 accelerometers (channel 17 – 22)
2 force transducers (channel 23 – 24)
7 turbine speeds (channel 25 - 31)
7 generators power production (channel 33 - 39)
4 displacement sensors (channel 33 – 36)
Wind measurement, speed and direction (channel 37 – 38)
84 strain gauges (channel 41 – 124)



HBM MGC+
data logging

PC
data storing, reduction, distribution

Up/download of PLC software

input channels

5	pres. res.
6	pres. res.
7	pres. res.
1	pres. u. pl.
2	pres. u. pl.
3	pres. u. pl.
4	pres. u. pl.
25	turb. speed
26	turb. speed
27	turb. speed
28	turb. speed
29	turb. speed
30	turb. speed
31	turb. speed

input channels

5	pres. res.
6	pres. res.
7	pres. res.
1	pres. u. pl.
2	pres. u. pl.
3	pres. u. pl.
4	pres. u. pl.
25	turb. speed
26	turb. speed
27	turb. speed
28	turb. speed
29	turb. speed
30	turb. speed
31	turb. speed

PLC
turbines/generators control

generator siphon

needed input:
- pressure under platform
- pressure in reservoir near turbine
- turbine/generator speed

calculates:
- turbine head
- optimal turbine/generator speed
- start/stop turbine/generator

output:
- set turbine/generator speed to optimal
- activate/deactivate siphon

PLC
floating level control

air pump/valves

needed input:
- pressure under platform
- pressure in reservoir near turbine
- turbine/generator speed

calculates:
- crest freeboard
- turbine head
- overtopping rate
- significant wave height
- optimal crest freeboard

output:
- activates air pump/valves so optimal crest freeboard is achieved

Instrumentation of Wave Dragon
Nissum Bredning model, DEA + EU project

JPK, 02.11.07

Inputs

Channel no.	Sensor description	Range	Placement	Spec.	Make	Model	Status	Modt.
1	Pressure cell, for salt water	0 - 2 m water pressure	on centerline, under ramp	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
2	Pressure cell, for salt water	0 - 2 m water pressure	on centerline, under center of gravity	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
3	Pressure cell, for salt water	0 - 2 m water pressure	under starboard, aft corner	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
4	Pressure cell, for salt water	0 - 2 m water pressure	under port, aft corner	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
5	Pressure cell, for salt water	0 - 2 m water pressure	in reservoir, in turbine area	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
6	Pressure cell, for salt water	0 - 2 m water pressure	in reservoir, in turbine area	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
7	Pressure cell, for salt water	0 - 2 m water pressure	in reservoir, in turbine area	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
8	Pressure cell, for salt water	0 - 2 m water pressure	on mooring pile, 1 - 3 m below MWL	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
9	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone 1	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
10	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone 2	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
11	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone 3	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
12	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone 4	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
13	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone 5	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	17-10-2002
	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone RESERVE	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	6-11-2002
	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone RESERVE	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	6-11-2002
	Pressure cell, for air tubes	0 - 2 m water pressure	in air chamber, zone RESERVE	DEA	Kulite	HKM-134-375M-1BarVG	Er bestilt 18/7-02	6-11-2002
17	Accelerometer	0 - 2 m/s^2	in control room, horizontal, parallel to centerline.	DEA			Er aftalt	
18	Accelerometer	0 - 2 m/s^2	in control room, vertical	DEA			Er aftalt	
19	Accelerometer	0 - 2 m/s^2	on starboard shoulder, vertical	DEA			Er aftalt	
20	Accelerometer	0 - 2 m/s^2	on port shoulder, vertical	DEA			Er aftalt	
21	Accelerometer	0 - 2 m/s^2	on port reflector, near pad eye for cross wire, horisontal, perpendicular to reflector	DEA			Er aftalt	
22	Accelerometer	0 - 2 m/s^2	on port reflector, near pad eye for cross wire, vertical	DEA			Er aftalt	
23	Force transducer	0 - 100 kN	in main mooring cable at pile	DEA	HBM	U2B-100	Er bestilt 11/10-02	
24	Force transducer	0 - 50 kN	in cross cable at starboard starboard reflector, on verical line close to shoulder	DEA	HBM	U2B-50	Er bestilt 11/10-02	
25	Turbine speed		Siphon turbine					
26	Turbine speed		Cylinder gate, 1. turbine, 1. group					
27	Turbine speed		Cylinder gate, 3. turbine, 1. group					
28	Turbine speed		Cylinder gate, 2. turbine, 1. group					
29	Turbine speed		Cylinder gate, 1. turbine, 2. group					
30	Turbine speed		Cylinder gate, 3. turbine, 2. group					
31	Turbine speed		Cylinder gate, 2. turbine, 2. group					
32								
33	Generator power production		Siphon turbine					
34	Generator power production		Cylinder gate, 1. turbine, 1. group					
35	Generator power production		Cylinder gate, 3. turbine, 1. group					
36	Generator power production		Cylinder gate, 2. turbine, 1. group					
37	Generator power production		Cylinder gate, 1. turbine, 2. group					
38	Generator power production		Cylinder gate, 3. turbine, 2. group					
39	Generator power production		Cylinder gate, 2. turbine, 2. group					
40								
33	Displacement sensor	1 - 3 m	in shoulder connection, in shoulder center line, 0.25 m above deck	EU Dur. eq. item 3 WP 1.5	ASM	PCQA21/1000	Er bestilt 11/10-02	
34	Displacement sensor	1 - 3 m	in shoulder connection, in shoulder center line, 1.75 m above deck	EU Dur. eq. item 3 WP 1.5	ASM	PCQA21/500	Er bestilt 11/10-02	
35	Displacement sensor	1 - 3 m	in shoulder connection, ortogonal to shoulder center line, 0.25 m above deck	EU Dur. eq. item 3 WP 1.5	ASM	WS12		
36	Displacement sensor	1 - 3 m	in shoulder connection, ortogonal to shoulder center line, 1.75 m above deck	EU Dur. eq. item 3 WP 1.5	ASM	WS12		
37	Wind speed sensor	0 - 70? m/s	On top of control room	EU Dur. eq. item 5 WP 1.5				
38	Wind direction sensor	0 - 360°	On top of control room	EU Dur. eq. item 5 WP 1.5				
39								
40								

Channel no.	Sensor description	Range	Placement	Spec.	Make	Model	Status	Modt.
41	SG rosette 1		SG 1 in rosette 1 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
42	SG rosette 2		SG 2 in rosette 1 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
43	SG rosette 3		SG 3 in rosette 1 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
44	SG rosette 1		SG 1 in rosette 2 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
45	SG rosette 2		SG 2 in rosette 2 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
46	SG rosette 3		SG 3 in rosette 2 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
47	SG rosette 1		SG 1 in rosette 3 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
48	SG rosette 2		SG 2 in rosette 3 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
49	SG rosette 3		SG 3 in rosette 3 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
50	SG rosette 1		SG 1 in rosette 4 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
51	SG rosette 2		SG 2 in rosette 4 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
52	SG rosette 3		SG 3 in rosette 4 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
53	SG rosette 1		SG 1 in rosette 5 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
54	SG rosette 2		SG 2 in rosette 5 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
55	SG rosette 3		SG 3 in rosette 5 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
56	SG rosette 1		SG 1 in rosette 6 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
57	SG rosette 2		SG 2 in rosette 6 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
58	SG rosette 3		SG 3 in rosette 6 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
59	SG rosette 1		SG 1 in rosette 7 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
60	SG rosette 2		SG 2 in rosette 7 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
61	SG rosette 3		SG 3 in rosette 7 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
62	SG rosette 1		SG 1 in rosette 8 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
63	SG rosette 2		SG 2 in rosette 8 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
64	SG rosette 3		SG 3 in rosette 8 in shoulder, on vertical line on outer plate between J and K, in side	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
65	SG rosette 1		SG 1 in rosette 1 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
66	SG rosette 2		SG 2 in rosette 1 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
67	SG rosette 3		SG 3 in rosette 1 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
68	SG rosette 1		SG 1 in rosette 2 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
69	SG rosette 2		SG 2 in rosette 2 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
70	SG rosette 3		SG 3 in rosette 2 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
71	SG rosette 1		SG 1 in rosette 3 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
72	SG rosette 2		SG 2 in rosette 3 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
73	SG rosette 3		SG 3 in rosette 3 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
74	SG rosette 1		SG 1 in rosette 4 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
75	SG rosette 2		SG 2 in rosette 4 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
76	SG rosette 3		SG 3 in rosette 4 in port reflector, on verical line close to cross wire connection	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
77	SG rosette 1		SG 1 in rosette 1 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
78	SG rosette 2		SG 2 in rosette 1 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
79	SG rosette 3		SG 3 in rosette 1 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
80	SG rosette 1		SG 1 in rosette 2 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	

Channel no.	Sensor description	Range	Placement	Spec.	Make	Model	Status	Modt.
81	SG rosette 2		SG 2 in rosette 2 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
82	SG rosette 3		SG 3 in rosette 2 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
83	SG rosette 1		SG 1 in rosette 3 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
84	SG rosette 2		SG 2 in rosette 3 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
85	SG rosette 3		SG 3 in rosette 3 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
86	SG rosette 1		SG 1 in rosette 4 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
87	SG rosette 2		SG 2 in rosette 4 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
88	SG rosette 3		SG 3 in rosette 4 in port reflector, on verical line close to shoulder	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
89	SG rosette 1		SG 1 in rosette 1 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
90	SG rosette 2		SG 2 in rosette 1 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
91	SG rosette 3		SG 3 in rosette 1 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
92	SG rosette 1		SG 1 in rosette 2 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
93	SG rosette 2		SG 2 in rosette 2 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
94	SG rosette 3		SG 3 in rosette 2 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
95	SG rosette 1		SG 1 in rosette 3 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
96	SG rosette 2		SG 2 in rosette 3 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
97	SG rosette 3		SG 3 in rosette 3 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
98	SG rosette 1		SG 1 in rosette 4 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
99	SG rosette 2		SG 2 in rosette 4 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
100	SG rosette 3		SG 3 in rosette 4 inside main beam, closest to ramp, on vertical line at CL	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
101	SG rosette 1		SG 1 in rosette 1 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
102	SG rosette 2		SG 2 in rosette 1 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
103	SG rosette 3		SG 3 in rosette 1 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
104	SG rosette 1		SG 1 in rosette 2 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
105	SG rosette 2		SG 2 in rosette 2 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
106	SG rosette 3		SG 3 in rosette 2 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
107	SG rosette 1		SG 1 in rosette 3 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
108	SG rosette 2		SG 2 in rosette 3 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
109	SG rosette 3		SG 3 in rosette 3 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
110	SG rosette 1		SG 1 in rosette 4 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
111	SG rosette 2		SG 2 in rosette 4 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
112	SG rosette 3		SG 3 in rosette 4 inside main beam, on wall parallel with and close to CL, on vertical line	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
113	SG rosette 1		SG 1 in rosette 1 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
114	SG rosette 2		SG 2 in rosette 1 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
115	SG rosette 3		SG 3 in rosette 1 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
116	SG rosette 1		SG 1 in rosette 2 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
117	SG rosette 2		SG 2 in rosette 2 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
118	SG rosette 3		SG 3 in rosette 2 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
119	SG rosette 1		SG 1 in rosette 3 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
120	SG rosette 2		SG 2 in rosette 3 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
121	SG rosette 3		SG 3 in rosette 3 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
122	SG rosette 1		SG 1 in rosette 4 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
123	SG rosette 2		SG 2 in rosette 4 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	
124	SG rosette 3		SG 3 in rosette 4 in port reflector, on verical line midway between shoulder and pa eye	EU Cons. item 3 WP 1.5	HBM		Er bestilt 11/10-02	

Spares:

Accelerometer	0 - 2 m/s^2	DEA/EU Cons. item 4 WP 1.5
Accelerometer	0 - 2 m/s^2	DEA/EU Cons. item 4 WP 1.5
Accelerometer	0 - 2 m/s^2	DEA/EU Cons. item 4 WP 1.5

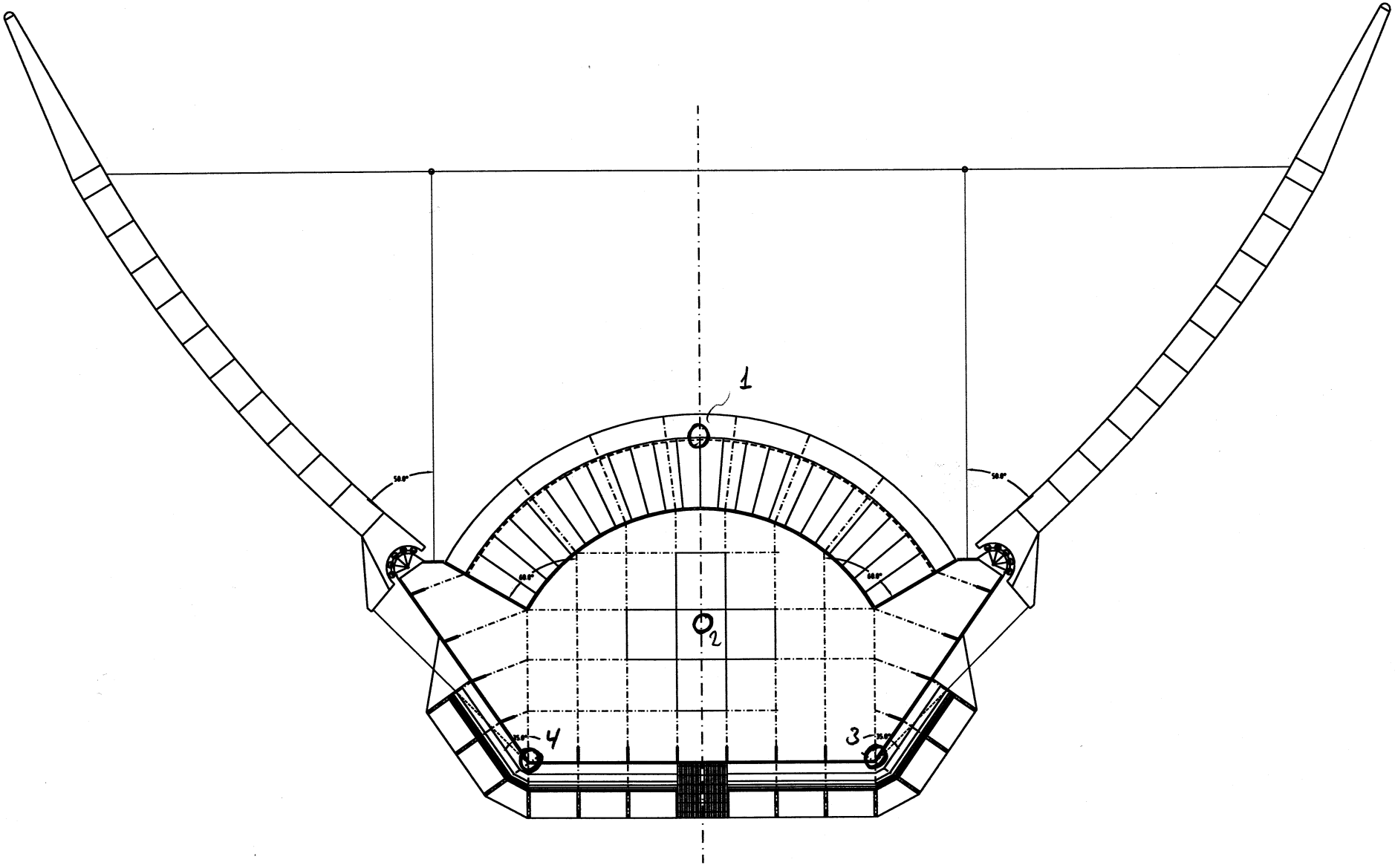
Placement	Spec.	Model	
MGC+ systems:			
Case			0
CP-32 "computer"			0
CATMAN software			0
PCMCIA harddisk			0
Network adapter			0
Other connections			0
Case			1
CP-32 "computer"			1
CATMAN software			1
PCMCIA harddisk			1
Network adapter			1
Other connections			1
MGC+ cards for 2 slots, pressure cells (16) (ML-801+AP-810)			2
MGC+ cards for 1 slots, force transducers (2) (ML-801+AP-810)			1
MGC+ cards for 2 slots, analogue in, acc., turb.sp., gen. power, displ., wind speed &dir (ML-801+AP-801)			2
MGC+ cards for 9 slots, strain gauges (84) (ML-801+AP-810)			0
Cables			1
Installation cables			1
Total			

PLC/SCADA system:			
Case			0
CP-32 "computer"			0
ML-70 "PLC"			1
AP-75 "analog out" (7 analog for generators for setting turbine speeds)			1
AP-78 "dig. out" (2 x 5 digital for valves to air chambers + 7 digital for siphon and cylinder gates)			3
Other connections			1
Communication bus			0
PC, industrial, in control room			0
Software, SCADA			0
Total			

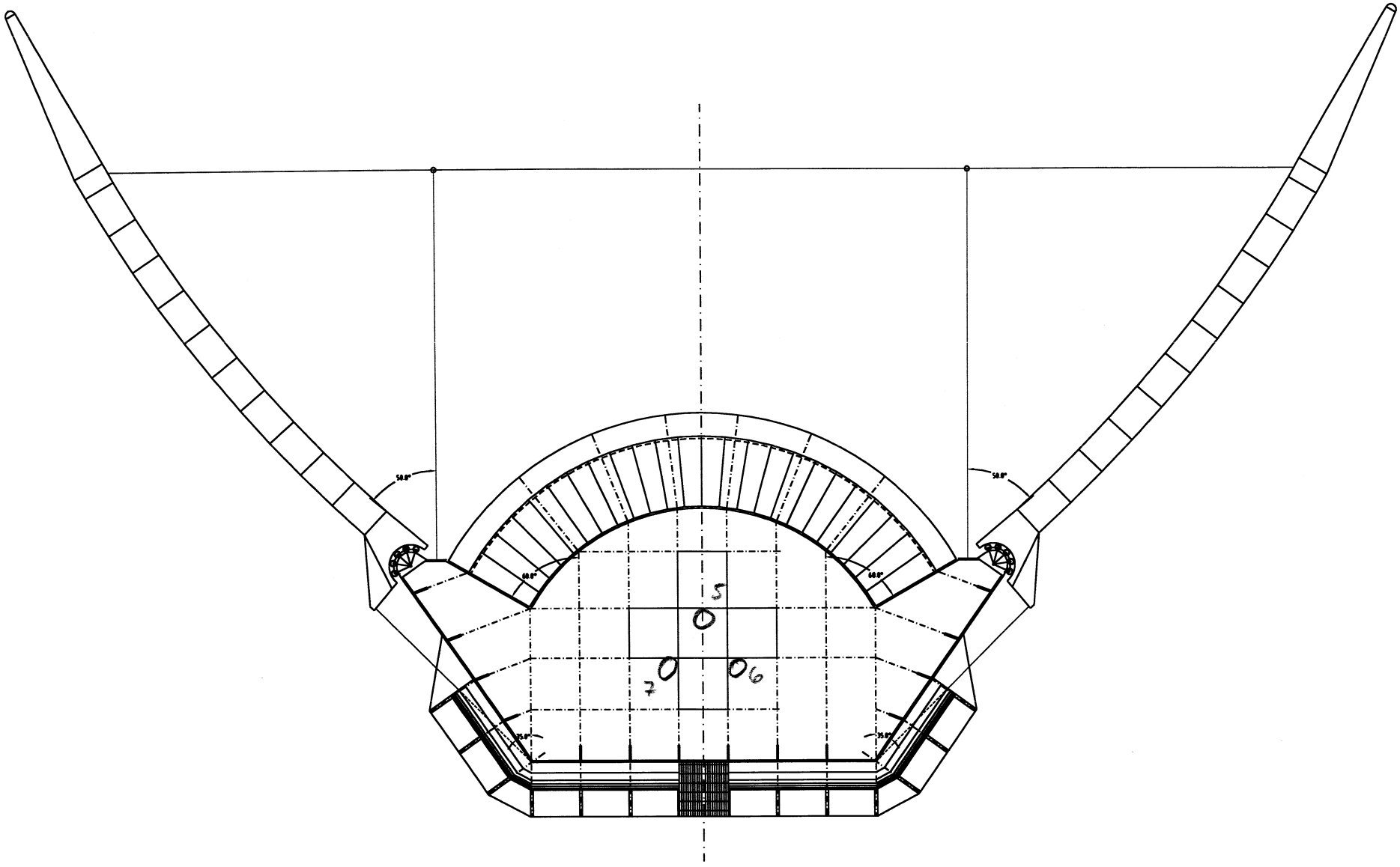
Surveillance camera:			
Pan and tilt surveillance camera			1
Housing			0
Waterproof cable, fittings etc.			0
Total			

Signal cable to shore (Cons. item 1 WP 1.3):			0

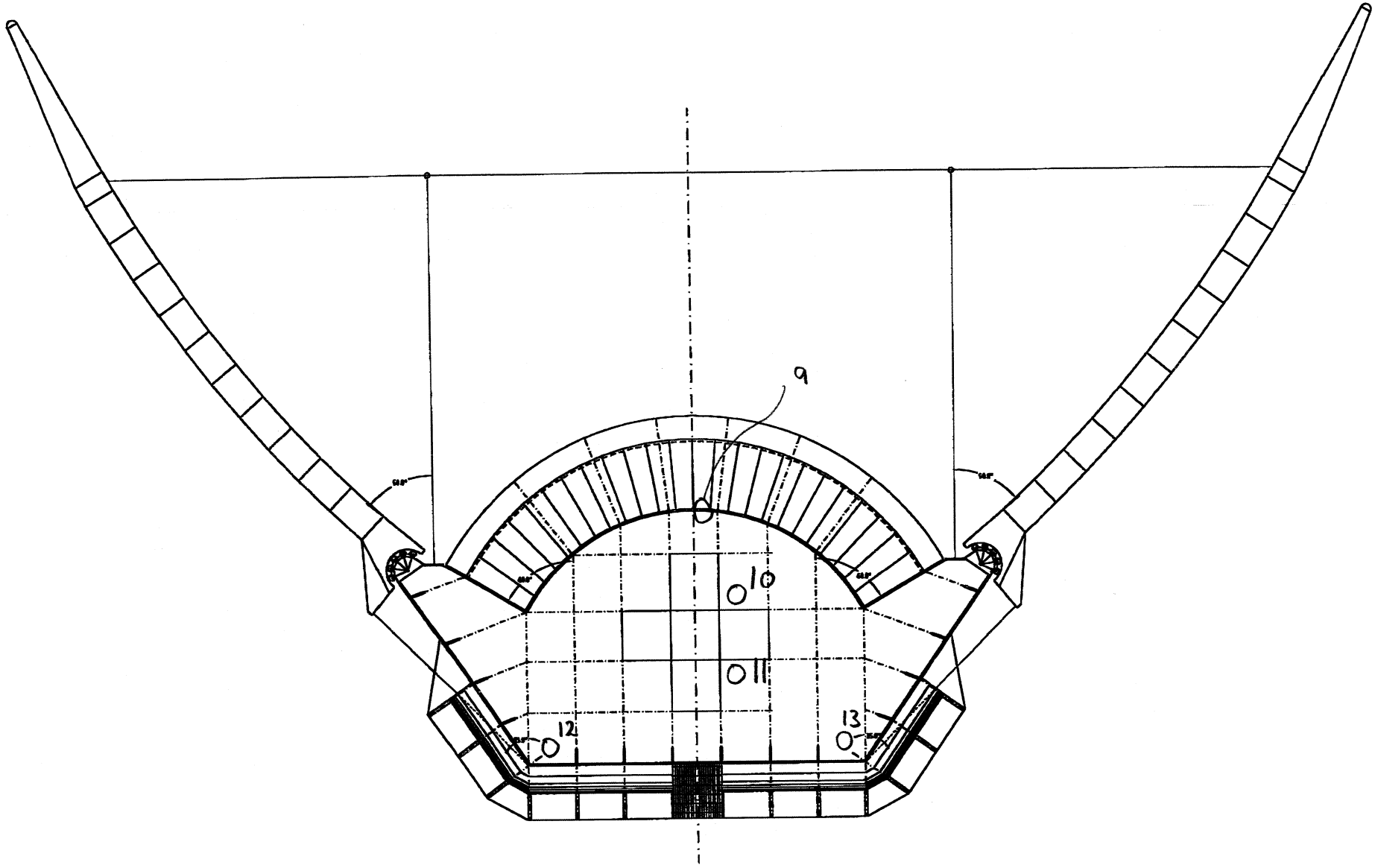
Placement of pressure transducers, under platform



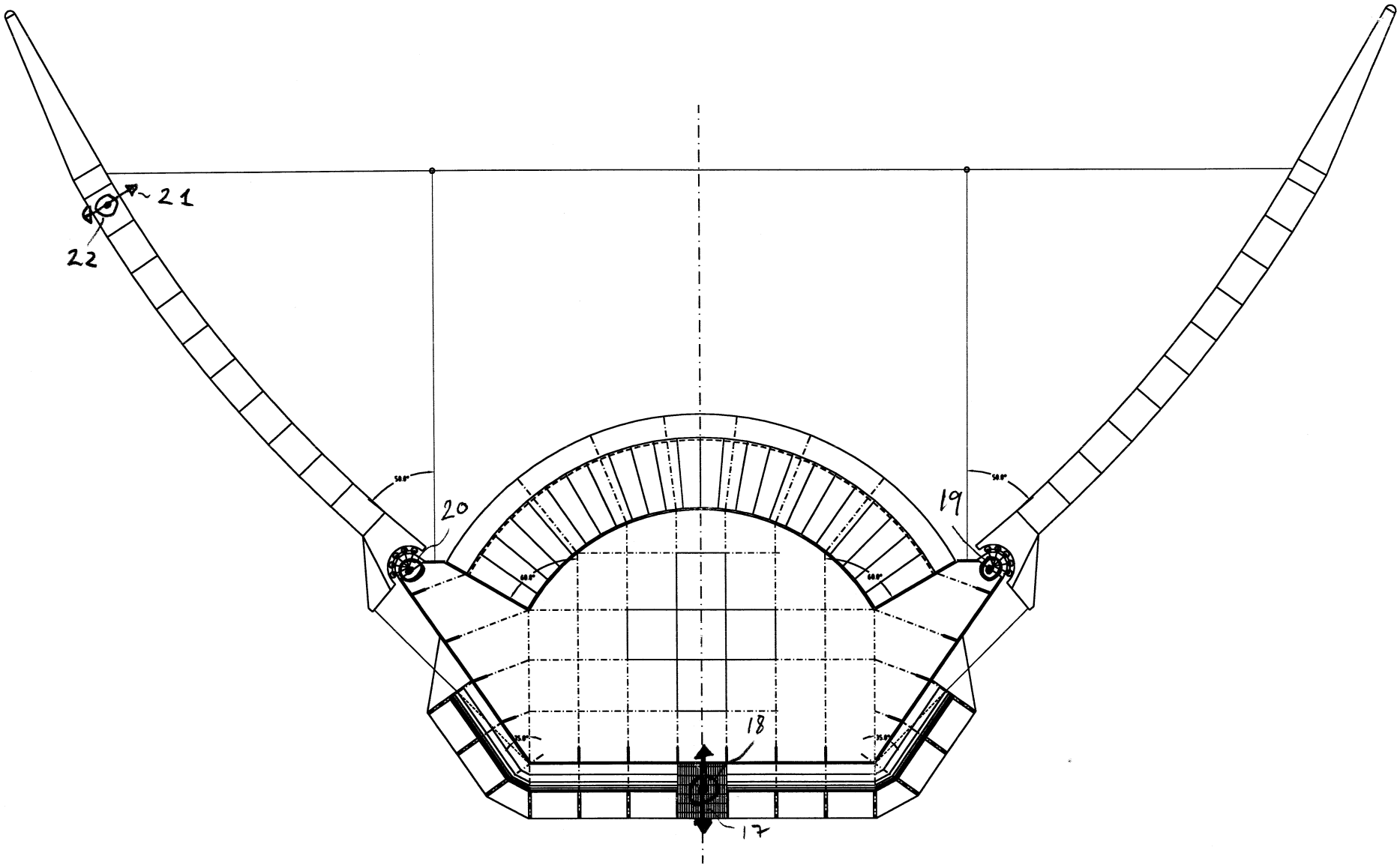
Placement of pressure transducers, in reservoir



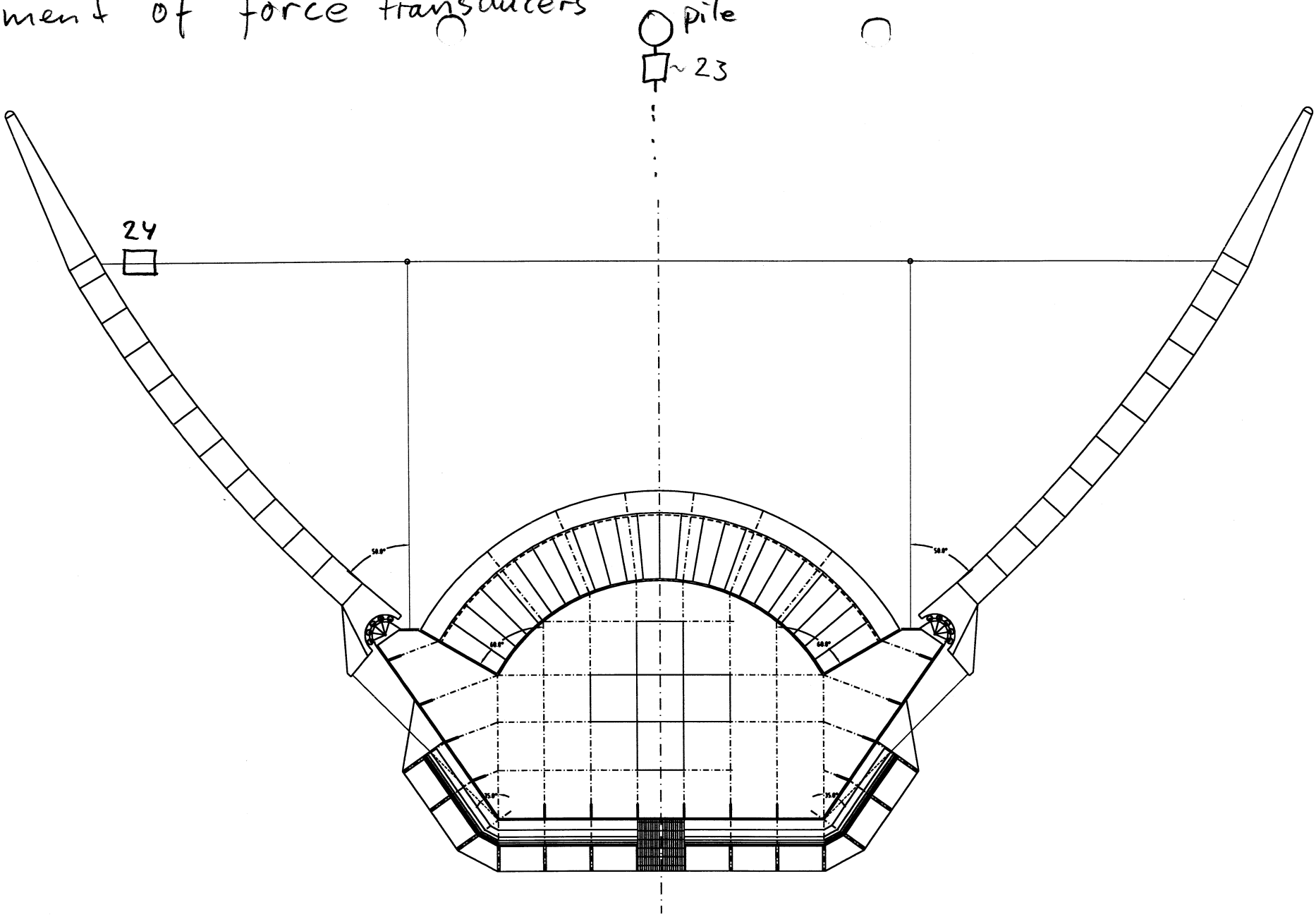
Placement of pressure transducers, air chambers



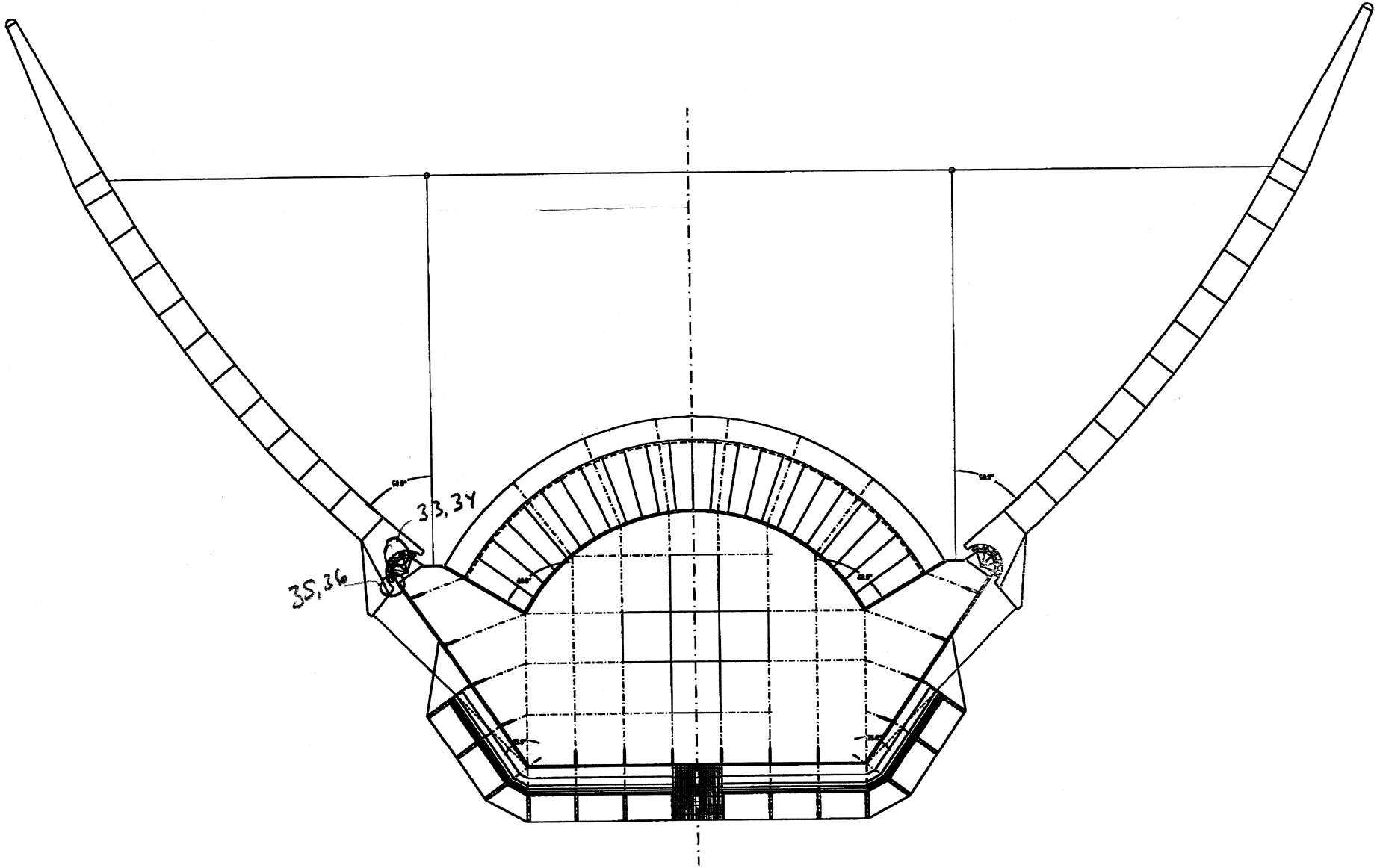
Placement of accelleromgters



Placement of force transducers

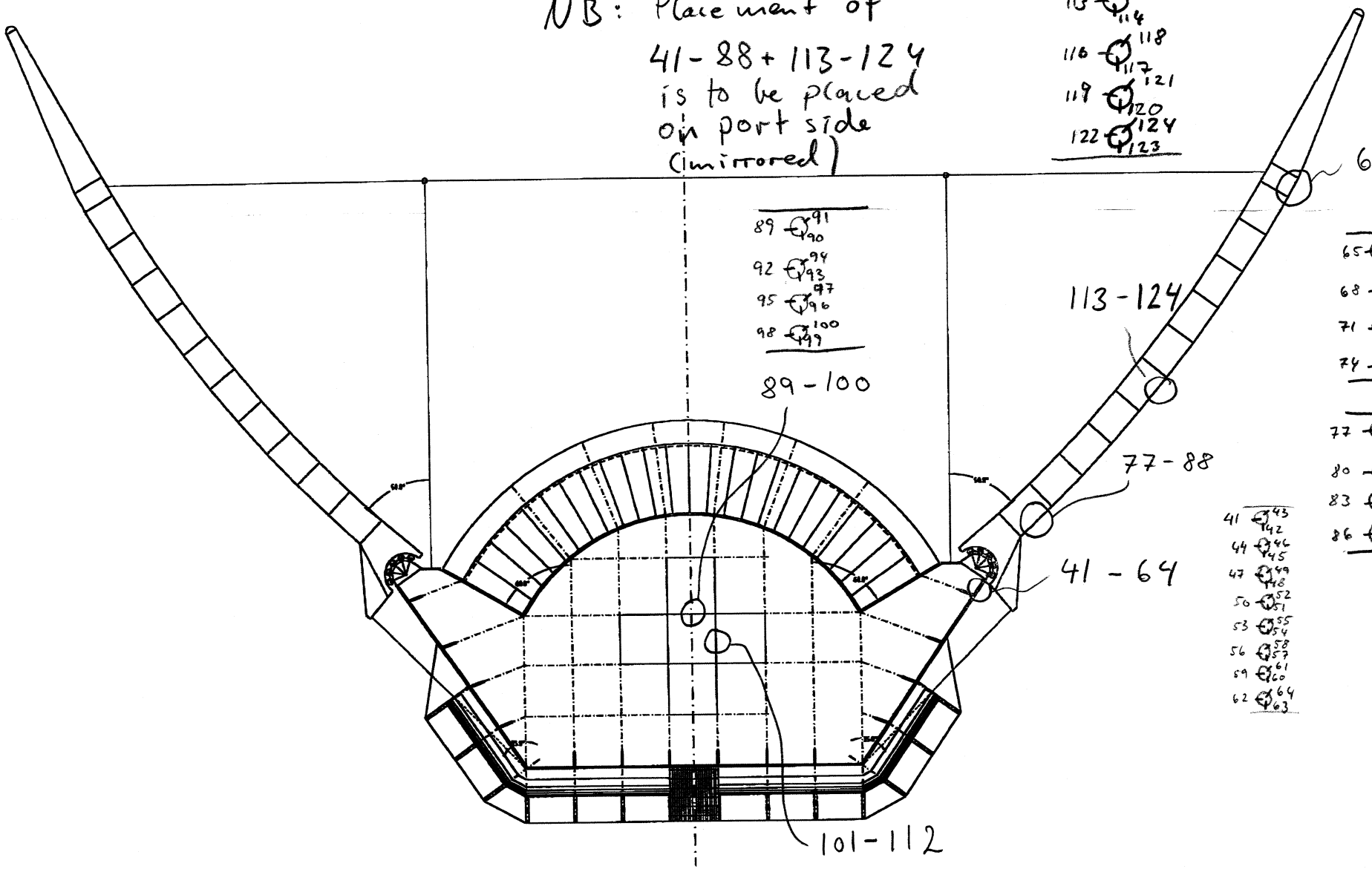


Placement of displacement sensors



Placement of strain gauges

NB: Placement of 41-88 + 113-124 is to be placed on port side (mirrored)



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02.10.10
JPK

Details for installation of transducers and description of interfaces

Generally, the transducers should be placed where indicated on drawing no. P01-038-A0001-02 WAVE DRAGON GENERAL ARRANGEMENT SENSOR & EQUIPMENT POSITIONS.
The exact location is flexible, but have to be recorded for use in the analysis of the measurements.
Generally, AAU will connect the transducers to a screw terminal in a box (eg. FIBOX PICCOLO Polycarbonat (IP67) 140 x 80 x 65), supplied together with the installation cable conducted by the constructor from the electrical panel in the control room to the approx. location of the transducer
AAU will also establish the connection from the electrical panel to the data acquisition system.

Pressure transducers under the structure, in reservoir and on pile (ch. 1 - 8)
Needed interface: angle iron with a 5/4" internal pipe thread, welded to the structure.
Each pressure transducer will be fitted by AAU into a unit protecting the transducer, which can be screwed into the 5/4" internal pipe thread, see fig. 1.
The transducers under the structure should be mounted vertically with the bottom of the 5/4" internal pipe thread at level with the bottom of the structure.
The transducers in the reservoir should be mounted horizontally facing approx. towards the center between the intakes to the turbines.
The transducer at the pile should be mounted vertically at a water depth of 2 m.
The pressure transducer is fitted with an 8 m wire including the venting wire.
This wire have to be connected to the installation cable at a position above a level were permanent water can occur.
Where appropriate, the box and screw terminal can be shared by more than cables to more than one transducer. The size of the box should then be chosen accordingly.
The box should be mounted with a screw terminal, and the installation cable connected to it.
The installation cable for theses transducers are RFA-HF(i) 2 x 2 x 0.5.

Pressure transducers for air chambers (ch. 9 - 13)
As above, except:
The 5/4" internal pipe thread should be placed in the reservoir deck, so the unit with the transducer is screwed into the pipe thread from above, see fig. 1.

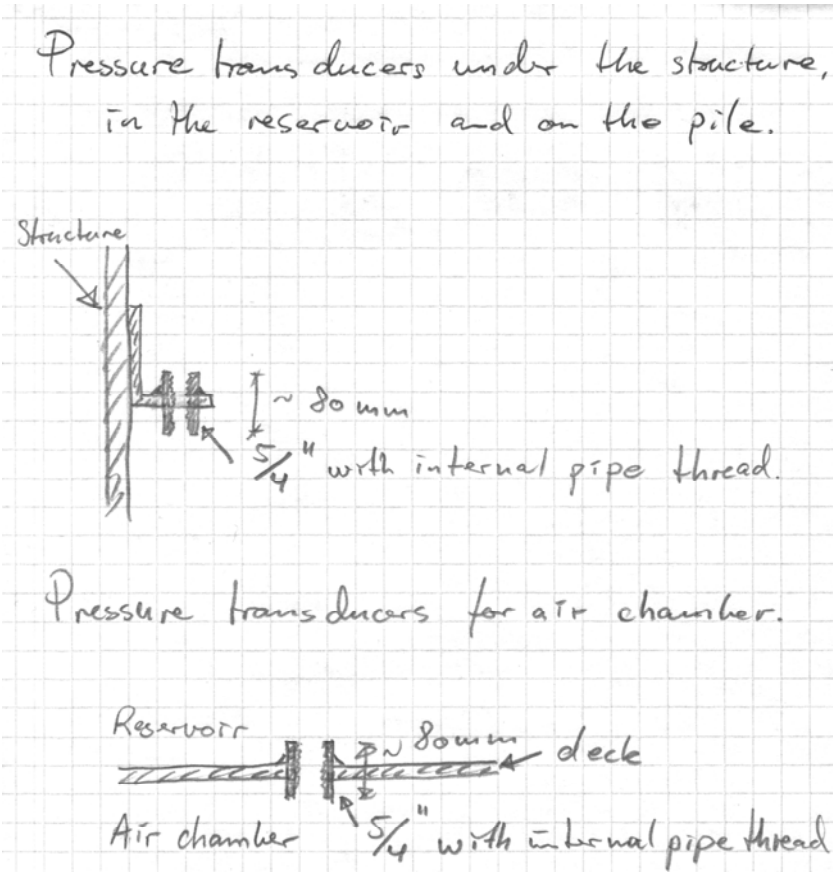

Fig. 1.

Accelerometers (ch. 17 - 22)
All the accelerometers are contained in a protecting box with a 90 x 150 mm mounting plate. The mounting plate has ø8 mm holes placed in the corners, see fig. 2.
Furthermore, there is a ø8 mm hole for venting of the box (to avoid condensed water).
For each of the accelerometers a console with dimensions as the mounting plate should be provided.
For the accelerometer in control room, horizontal, parallel to centerline (ch. 17) the console plate can be mounted on the end wall (horizontal, parallel to centerline).
For the accelerometer in control room, vertical (ch. 18) the console plate can be mounted on the end wall (vertically).
The wire from the electrical panel approx. to the accelerometers should be provided. No box and screw terminal is needed. AAU will provide appropriate connectors.
For the accelerometer on starboard shoulder, vertical (ch. 19) the console plate can be mounted on a column (eg. a quadratic 100 x 100 mm profile) placed vertically against the bulwark (vertically), see fig. 3.
For the accelerometer on port shoulder, vertical (ch. 20) the console plate can be mounted on the column for the displacement sensors (vertically), see fig. 5.
Screw terminals are not needed in the connection boxes for the accelerometers. AAU will provide and mount connectors on both wires from accelerometers and installation cables.
The boxes with screw terminals can also be placed on the columns.
For the accelerometers on port reflector, near pad eye for cross wire, horizontal (perpendicular to reflector) and vertical (ch. 21 and 22) the console plates should be mounted on a column.
The column (eg. a quadratic 100 x 100 mm profile) can be welded vertically on the back side of the reflector beam (between web e and f).

The console plate for the horizontal accelerometer can be placed at the top of the column.
The vertical accelerometer can be mounted directly on the column, near the top of the column.
A common connection box for both accelerometers can also be placed near the top of the column.
Screw terminals are not needed in this connection box. AAU will provide and mount connectors on both wires from accelerometers and installation cables.
The installation cable for theses transducers are RFA-HF(i) 4 x 2 x 0.5.

Console for accelerometers:

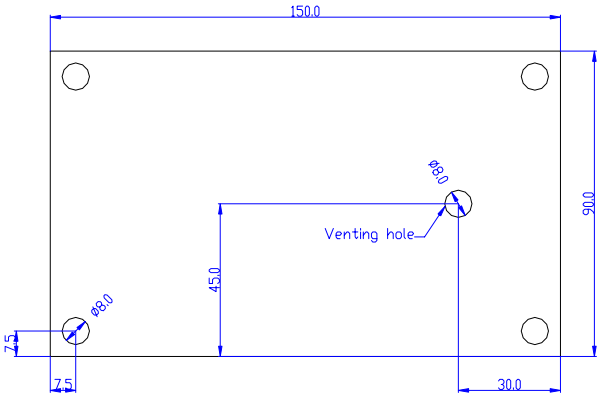

Fig. 2.

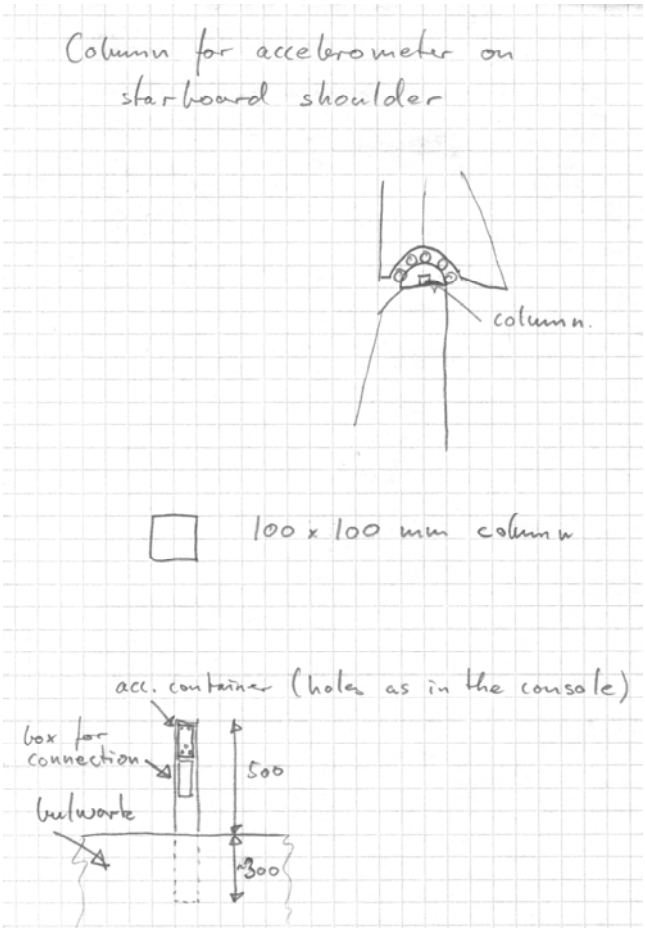

Fig. 3.

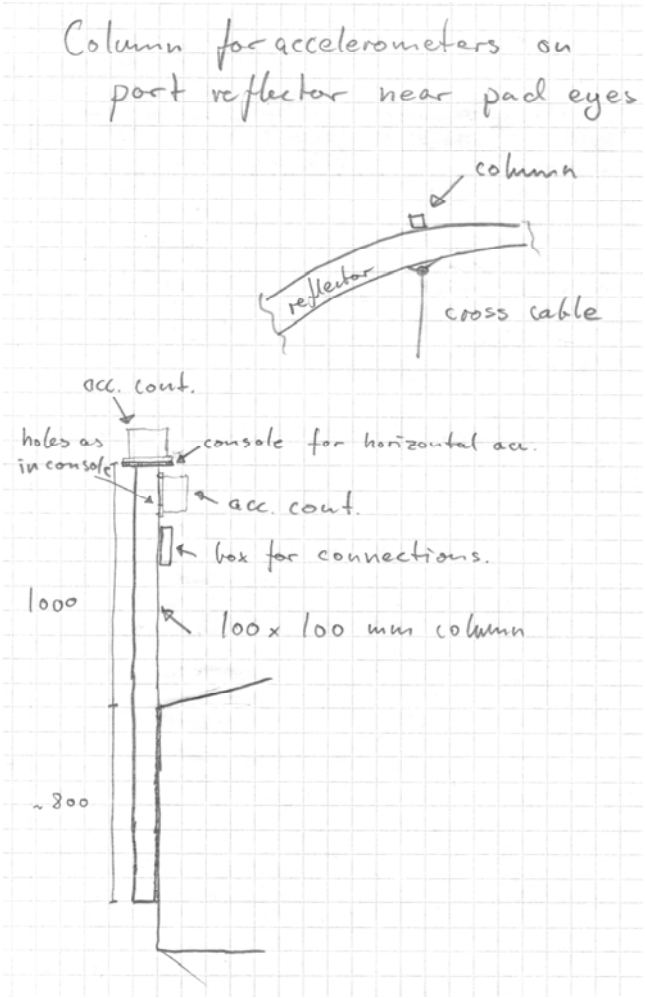

Fig. 4

Force transducers (ch. 23 - 24)
AAU will fit the force transducers in the main and cross cables with knuckle eyes or shackles. The distance from the two attachment points will be approx. 0.5 m.
The installation cables will either be connected directly to the transducers or connected to the wires from the transducers in the box for the pressure transducer at the pile (ch. 23, main)
and the box for the accelerometers near the pad eyes on the port reflector (ch. 24, cross)
The installation cable for ch. 23 (main) and for ch. 24 (cross) is RFA-HF(i) 4 x 2 x 0.5.

Displacement sensors (ch. 33 - 34)
The displacement sensors are to be placed on a column on the bulwark facing the port shoulder connection. Another column is to be placed opposite on the reflector arm. See fig. 5.
It might be necessary to stabilize the columns by stay wires.
Two console plates (eg. 100 x 100 x 8 mm) should be welded on the column to which the displacement sensors can be fixed. AAU will drill the holes when installing the sensors.
AAU will also install the necessary reels and hooks for the measurement wires connecting the two column.
The displacement sensors are to be connected to the installation cables in a box also placed on the same column as the sensors.
This box will also contain the connection for the accelerometer placed on the column.

The installation cable for theses transducers are RFA-HF(i) 4 x 2 x 0.5.

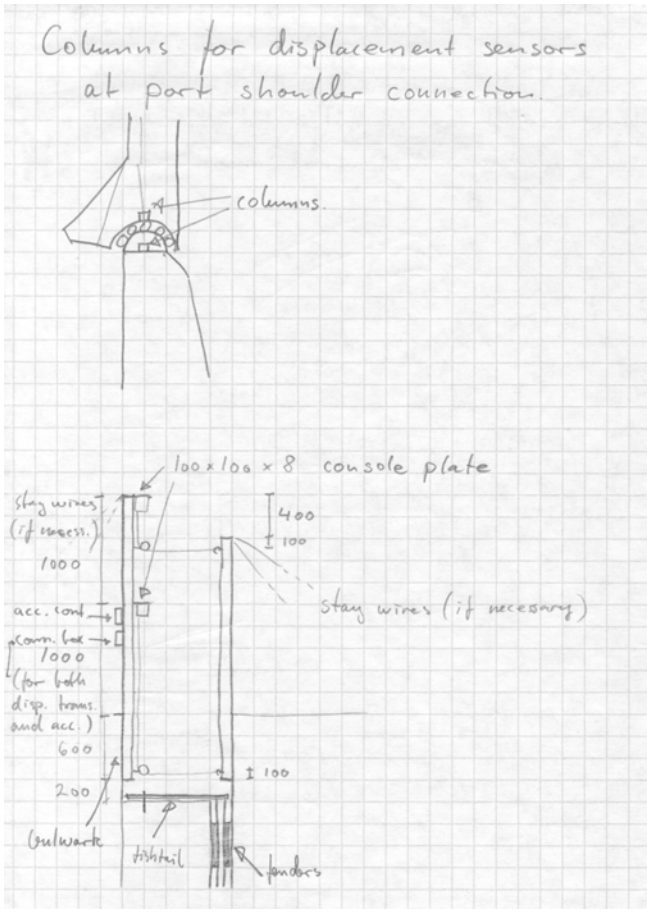

Fig. 5

Strain gauges (ch. 41 - 124)
The strain gauges will be mounted directly on the structure and connected to the installation cables by AAU.
No consoles or other preparation is needed.
The installation cables should be provided in a number of boxes, as follows.
In port shoulder (ch. 41 - 64) installation cables end in box for 4 x 24 wires.
In port reflector near pad eye (ch. 65 - 76) installation cables end in a box for 4 x 12 wires.
In port reflector near shoulder connection (ch. 77 - 88) installation cables end in a box for 4 x 12 wires.
In center of main bean in platform installation cables end in two boxes for 4 x 12 wires (ch. 89 - 100) and for 4 x 12 wires (ch. 101 - 112).
In port reflector midway between shoulder connection and pad eye (ch. 113 - 124) installation cables end in a box for 4 x 12 wires.
The installation cable for theses transducers are RFA-HF(i) 2 x 2 x 0.5.

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03.01.05
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Funktionskrav til netværk og internetforbindelse på WD-NS

Internetforbindelsen antages etableret som en 256 kbps up/download ADSL forbindelse. Mellem ADSL forbindelsen og netværket på WD installeres en firewall/proxyserver, der skal sikre mod uvedkommendes adgang til netværket, men stadig tillade den ønskede adgang til udvalgte brugere. Man skal fra netværket på WD have de sædvanlige muligheder, der følger med en almindelig internetforbindelse, såsom mulighed for at

- up/downloade filer via ftp til andre servere.
- checke e-mail.
- etc.

Derudover skal det være muligt udfra, for udvalgte brugere, at få direkte adgang til PC'ere på netværket på WD. Her tænkes specielt på at der skal være adgang til at fjernstyre PC'en, der bruges til opsamling af data samt programmering af PLC'en, via NetOp, PcAnywhere eller lignende. Endvidere skal det være muligt at gå direkte på fx et webcam med egen ip-adresse udefra – igen kun for udvalgte brugere. I første omgang vil de udvalgte brugere formentlig være AAU, Wave Dragon Test, Balslev og TUM.

Netværket på WD forventes at komme til på sigt komme til at bestå af følgende:

- PC der bruges til opsamling af data samt programmering af PLC'en.
- PC hvortil webcams er tilsluttet.
- Webcams med egen netværksport.
- Medbragte notebooks til flytning af data.

Typiske brugssituationer kunne tænkes at være:

- AAU tømmer MGC+ enheden for data, Balslev om programmerer PLC'en, etc., ved at gå direkte på PC på WD netværket via fx NetOp.
- AAU checker mail, uploader filer, etc., fra PC på WD netværket.
- Webcams uploader billeder til webserver.
- Webcam streaming til webserver med pan/tilt/zoom styring af webcam. Fx som www.onair.dk.

Skal der anbringes en router på WD?
Skal der oprettes et VPN (Virtual Private Network) for de udvalgte brugere?
Hvilke krav stiller de skitserede ønsker til de udvalgte brugeres netværk/internetforbindelser?