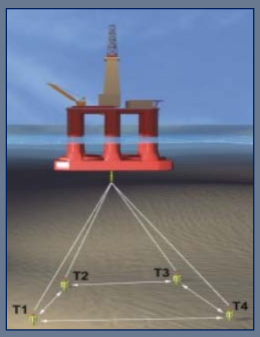
LBL CALIBRATION



INTRODUCTION

The purpose of this section is to give you some of the theoretical background information needed for LBL calibration and MULBL setup

The section is written for general operation and you might therefore find topics not relevant for your use of the system

Note that file names, water depths, channel numbers, values in default parameters, interrogation interval, and other settings might be different in live operations than in the screen dumps in this section

Note that the screen dumps in this training manual are taken with different APOS software versions and not necessarily fit the software you have on-board or in a standard APOS Trainer

Special simulator and setting files must be installed on an APOS Trainer to get the same screen dumps as in this section

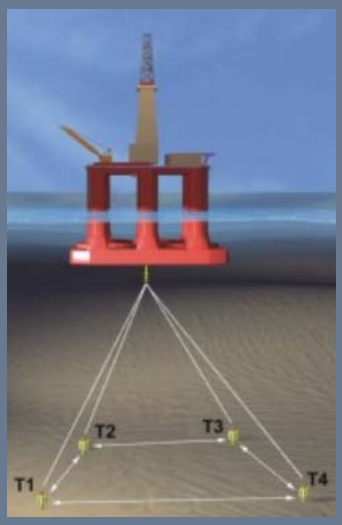
DOCUMENT LOGISTICS

Revision	Date	Written by
— A	25.09.00	TOS
— B	18.01.01	TOS
— C	03.04.01	TOS
— D	06.08.01	TOS

History	Changes
— A	First edition
— B	Minor changes
— C	Removed slides : Geographical calibration Removed slides : Error ellipsis New slides : Recover array transponders
— D	New information about LBL runtime calibration and wizard Layout changed to fit new graphical profile

WHAT IS LBL CALIBRATION ?

Long base line calibration is to decide the local coordinate system of the transponders deployed for use in an LBL array



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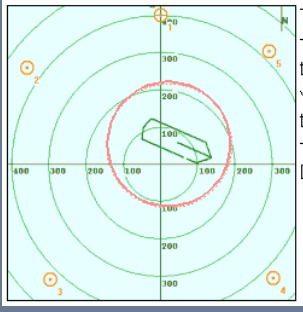
PLANNING A LBL ARRAY

When planning an array, there are a few things to consider:

- operation area
- ships system/seabed footprint
- transponder type/surface footprint
- LBL transponder channels
- number of transponders
- array radius
- transponders with clump weight
- pre-deployment checks of transponders
- check list prior to deployment

OPERATION AREA

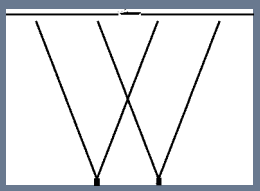


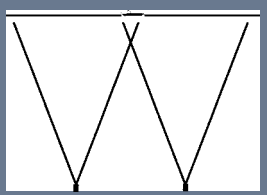
The area the vessel needs to manoeuvre in defines the operation area.

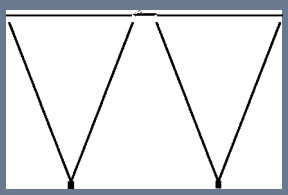
This might also influence on the choice of transponder type, number of transponders and array radius.

You should have a good coverage (contact) from the transponders throughout your operation area.

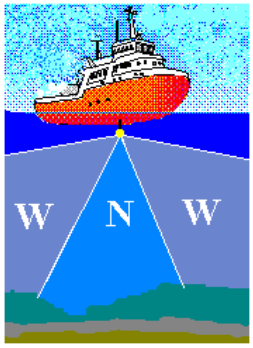
Take also the vessel heading into consideration when planning an array. Do risers/parts of the hull obstruct certain directions?







SEABED FOOTPRINT - TRANSDUCER BEAMS



The transducer footprint on the seabed is determined by the system/transducer on board. This picture shows a narrow/wide beam transducer coverage area. The narrow beam area is indicated by a "N", and the wide beam area indicated by "N"+"W".

HPR418 systems with narrow/wide transducer (so-called narrow beam transducer) covers ± 22.5° in narrow beam and ± 80° in wide beam. Wide beam is more affected by noise than narrow beam.

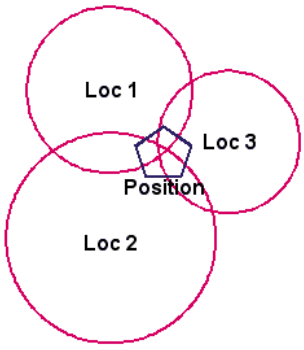
HPR418 systems with medium/wide transducer (so-called standard transducer) covers ± 55° in medium beam and ± 80° in wide beam. Wide beam is more affected by noise than medium beam.

HiPAP500 systems will cover ± 100° from the vertical. The HiPAP500 will always make ± 5° narrow beams within the whole coverage area, since this is controlled electronically.

HiPAP350 systems will cover ± 60° from the vertical. The HiPAP350 will always make ± 15° narrow beams within the whole coverage area, since this is controlled electronically.

NUMBER OF TRANSPONDERS

The LBL system works as a range-range system. The transponders on the seabed have known positions when the local calibration is successfully completed.



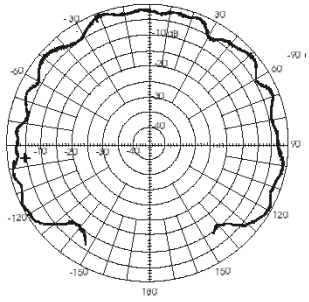
When positioning in LBL, the range measured from each transponder is the radius of a sphere. The vessel position is where the spheres from the different locations intersect. In order to establish a position on the surface, a minimum of 3 ranges must be measured.

However, using only 3 transponders in an array is not recommended. The user has to consider possible "blind spots" from the transponders caused by raisers or structures/hull.

Using 4 transponders, or preferably 5, gives redundancy in the range measurements. When using 5 or more transponders, a special software function can be used (auto-exclude), which will process the range measurements and remove incorrect ranges. These ranges can be caused by reflections (not line-of-sight between transponder and vessel) or interference from other transponders (used by other vessels nearby).

SURFACE FOOTPRINT - WIDE BEAM

The transponder footprint on the surface is dependent on the type of transponder used.



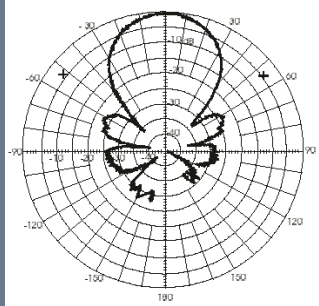
MPT 339 series
Source level = 195 dB

MPT319/MPT339:

The opening angle (cone) of these transponders is ± 90° (hemispherical).

SURFACE FOOTPRINT - NARROW BEAM

The transponder footprint on the surface is dependent on the type of transponder used.



SPT 331 series
MPT 331/DuB vertical
Source level = 206 dB

MPT331DuB:

This transponder type has got dual beams (DuB). One beam pointing upwards during positioning, while there is a horizontal beam during base line measurements. The opening angle (cone) for the vertical beam is ± 15°. The horizontal cone (doughnut) is also ± 15°.

Choosing the transponder type:

In general, transponders with narrow beam transducers are more powerful than transponders with wider beam transducers, but the drawback is a reduced footprint on the surface.

Normally the water depth determines the type of transponder to use.

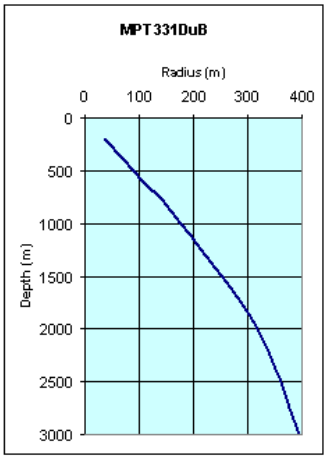
-1000m: MPT319 transponder if the ambient noise level on the vessel is low. If the noise level is high, a MPT339 or MPT331DuB might be used.

Note: The MPT331DuB might restrict the operation area due to the narrow beam of the transponder.

-3000m: MPT339/MPT331DuB transponders. For drilling units with azimuth thrusters (high noise level) MPT331DuB is recommended, as these have higher source level (output) than MPT339.

As you can see from the lobe diagram, the MPT331DuB transponder has a very distinct and powerful beam.

ARRAY RADIUS - NARROW BEAM TP



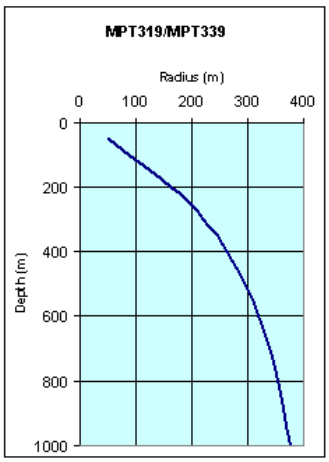
Deep water:

For deepwater operations, the radius is determined by the beams of the transponders. This gives a radius equal to about 10° from the centre for the MPT331DuB type.

The reason for choosing 10° instead of 15° (which is the opening angle for MPT331DuB transponders) is to have some overlap for vessel movements on the surface. Also the transponders might "lean over" from current or soft seabed depending on the type of installation.

The graph shows the water depth/array radius using a 10° array, which is reduced somewhat below 1500-2000m depth.

ARRAY RADIUS - WIDE BEAM TP



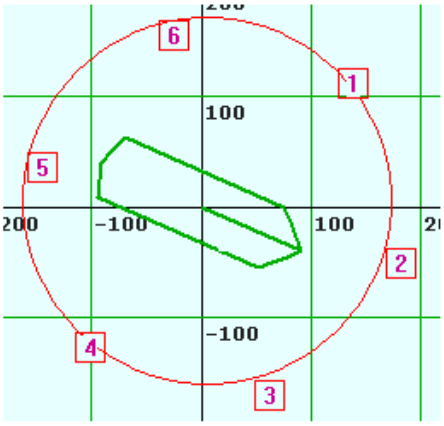
Shallow water:

For shallow water/less noisy environment the MPT319/MPT339 (1000m/3000m depth rating) transponders can be used. The beam patterns of these transponders are wider, which allows the user to make a wider array. The baselines are much depending on what type of transducer is used on the vessel (refer to the paragraph "Ships system/seabed footprint"). The system should work inside the narrow/medium beam.

You might encounter other problems having a wide array. The topography of the seabed might be blocking the direct line between the transponders, making baseline measurements difficult, or even impossible.

The graph shows the water depth/array radius for MPT319/339 transponders, starting at 45° and reduced to 20° at 1000m. This to avoid the long baselines.

ARRAY GEOMETRY

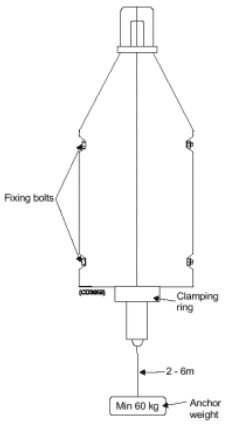


Normally the transponders are evenly spaced around the circle (as seen here with 6 transponders). The transponders need "line-of-sight" between them to do the baseline measurements. Adjust the positions if necessary if structures/templates etc. is already placed on the seabed.

Once the calibration is done, objects on the seabed will not cause any problems.

TRANSPONDERS WITH CLUMP WEIGHT

Transponders used in LBL arrays might be deployed in transponder stands or with flotation collar and clump weight.



When deploying transponders with clump weight, they can either be dropped over the side or launched by ROV, winch or drill string.

Normally the clump weight should be 60-70kg. The rope or wire attached between the clump weight and transponder can be 2-6m. The buoyancy of a MPT331DuB transponder and flotation collar is 23kg and for MPT319 transponder and flotation collar 17kg.

If dropping transponders over the side, also take the current into consideration as the transponders might drift off and land far away from the intended position. Increasing the clump weight might decrease the drift-off.

When the seabed topography is "bumpy", longer ropes/wires between the clump weight and transponder might be considered to ensure "line-of-sight" between the transponders.

NOTE! The transponder AND clump weight should NOT be lifted by the transponder cage, as the cage is certified for the weight of the transponder and flotation collar only.

Attach the lifting gear directly to the clump weight.

LBL TRANSPONDER CHANNELS

The last digit of the channel numbers of the transponders in the LBL array must be different, and the first digit of all transponders must be either even or odd. If the channel numbers of the transponders do not obey these rules, some of the channels must be changed. It is either done by changing the internal switches in the transponder before deployment, or with telemetry during the pre-deployment check using telemetry. Make a note of all channels/serial numbers as they are needed later.

Example of an array that follows the rules: B13, B38, B51, B72, B14

PRE DEPLOYMENT CHECK LIST

After having decided which transponders to use, make sure they are all ready for use.

Check the last ping-count (either on the APOS operator station or in a separate transponder logbook) to ensure the transponder batteries will last for the whole period of intended use. If in doubt, change the batteries.

If you are using a HPR418 system equipped with a test transducer, check the ping count and to do telemetry/release checks on deck. If not, the best way to do a check in advance is to put the transponders in a basket (secure them to the basket!) and lower the basket by crane to a position below the hull near the ships transducer. Test the transponders, both in navigation mode and telemetry. As a check, read the ping count and execute the "release" command if the transponders are going to be released acoustically later.

- Serial numbers/channels noted
- Channels comply with requirements
- Transponder data entered in the APOS database
- Planned array depth/radius ratio (operation area/footprint) OK
- Remaining battery capacity OK/battery changed
- Navigation/telemetry check to each transponder OK
- Clump weight/wire attached
- Transponders ready for deployment (winch/ROV/free-fall)

NEW LBL ARRAY WIZARD APPROACH

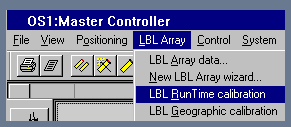
The purpose of the wizard is to:

- Define and prepare a new LBL array ready for positioning (any existing information may be removed).

The wizard has following pages:

- Prepare LBL-calibration
- LBL channels
- Measuring baselines
- Set position mode

LBL RUNTIME CALIBRATION APPROACH



The purpose of the LBL runtime calibration is to calculate the co-ordinates of the locations in the LBL array. The calculation is based on the LBL measurements done by the vessel when positioning in LBL.

The vessel must be able to position in LBL before the run time calibration can be done. The positions of the locations used in the positioning can be decided in one of two ways:

- The initial co-ordinates of the locations are often decided by using the transponders SSBL positions. They can be transferred to the calibrated positions. Normally these positions are more than good enough for the LBL positioning to start.
- The ranges (baselines) between the locations are measured. These ranges are used in a local calibration to decide the calibrated positions of the locations. This procedure gives the most accurate relative position of the locations. It does not, however, give you any better accuracy in the orientation of the array and in the depth of the locations.

LBL ARRAY DATA APPROACH - STEP BY STEP

The purpose of this section is to give you an overview of the steps that are necessary to establish an LBL array and to start the positioning of the vessel in LBL. More detailed information is found in other the Help sections.

The steps are grouped as shown below.

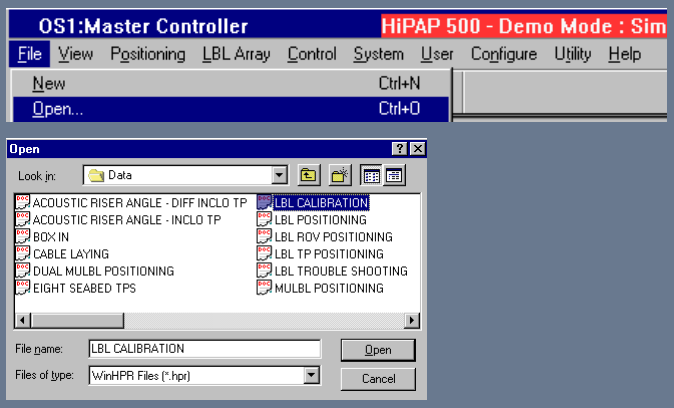
1. Preparations
   The transponders to be used in the LBL array are defined with respect to serial number, channel and parameters.
2. Define the LBL array
   The transponders in the LBL array are selected, and their initial co-ordinates are decided.
3. Tp Array & Tp Parameters.
   Often the default parameters may be used. Then this part may be omitted
4. Local calibration.
   The baselines between the transponders are measured, and the local calibration is done.
5. Prepare for LBL positioning.
   The turnaround delays of the transponders and the common interrogation channel of the LBL array are decided.
6. LBL positioning.
   The parameters to be used in the positioning are determined, and the positioning is started.

GEOGRAPHICAL CALIBRATION APPROACH

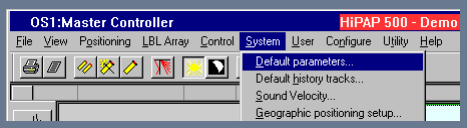
The purpose of the dialog is to:

- Control the logging of the dGPS and LBL position pairs.
- Calculate the geographical position of the LBL origin based on the position pairs logged.

OPEN FILE WITH CONFIGURED TRANSPONDERS

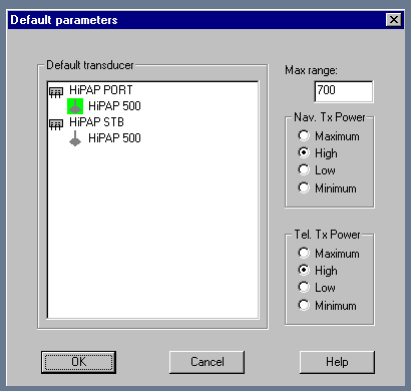


DEFAULT PARAMETERS

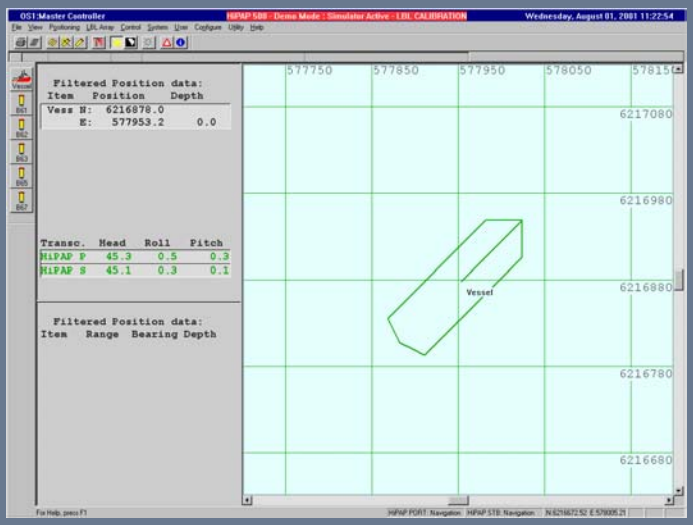


The maximum range is set by clicking in the Max Range field and type in the new max range. Replies outside this range are rejected by the system, so pay attention to this setting. An extremely long range compared to the actual might slow down the update rate when the system is searching for transponders.

High power is normally suitable for most operations.



ARRAY RADIUS AS MARKER



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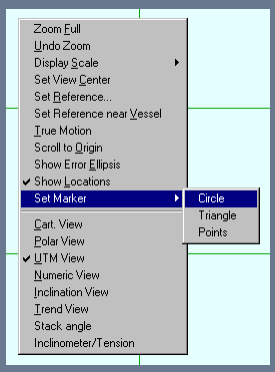
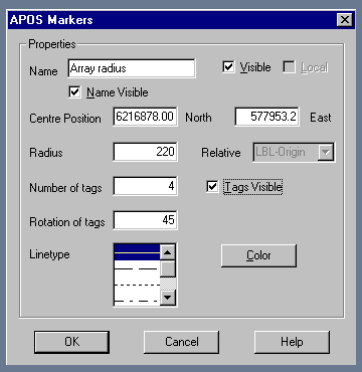
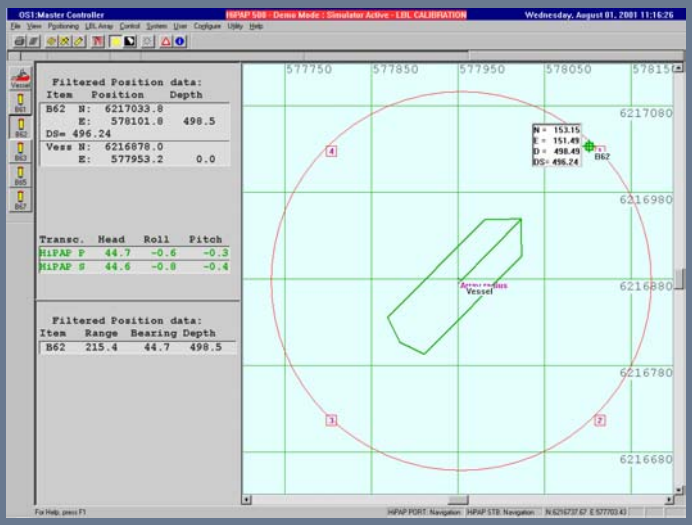
ARRAY RADIUS AS MARKER





DEPLOY AND MONITOR TRANSPONDER



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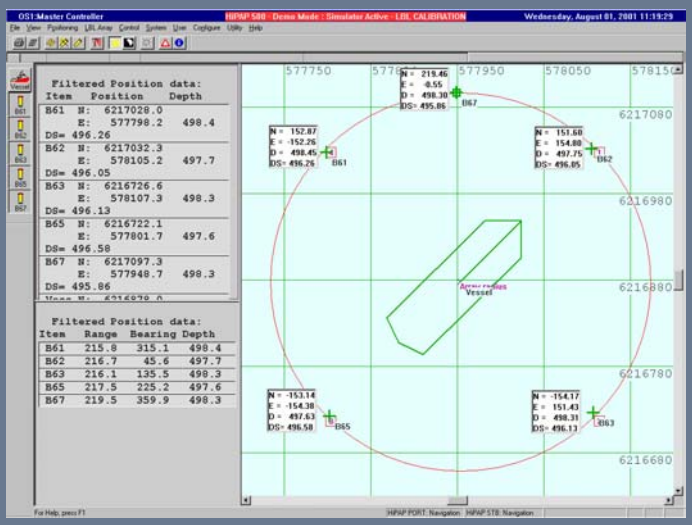
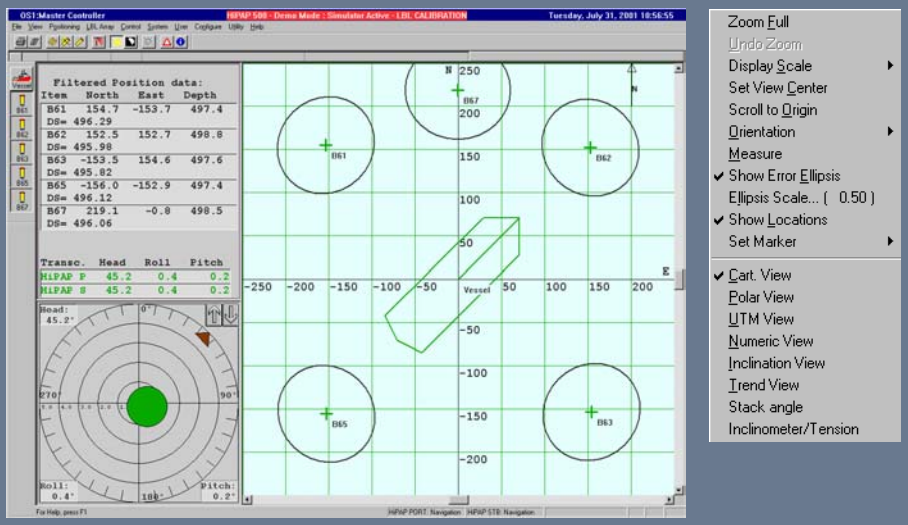
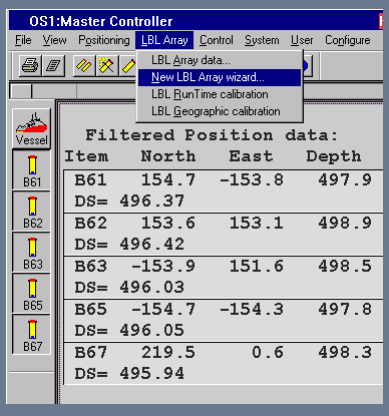
DEPLOY AND MONITOR TRANSPONDER



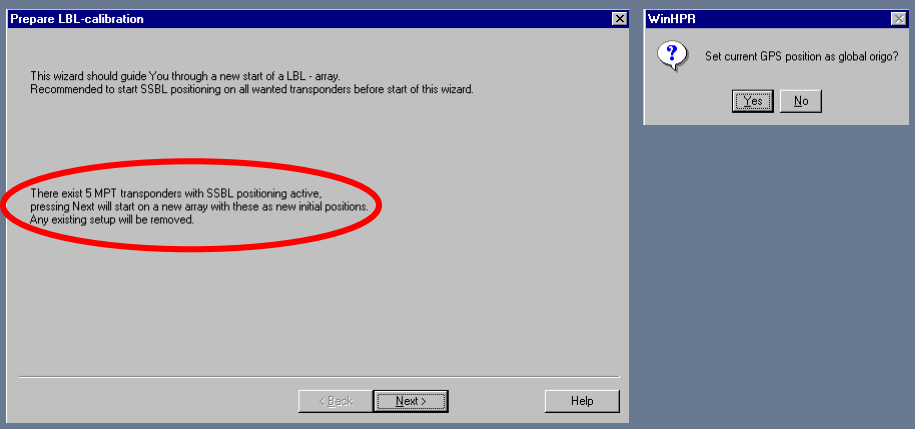
SSBL POSITIONING



OPEN NEW LBL ARRAY WIZARD

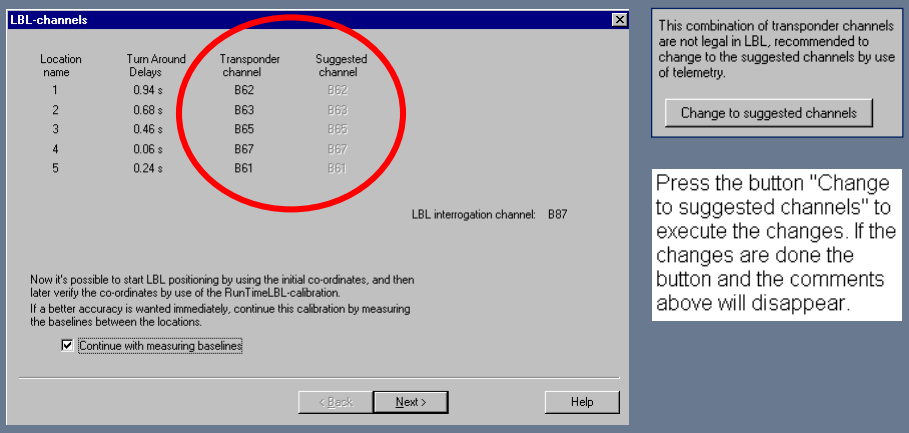


PREPARE LBL CALIBRATION



By pressing "Next" all earlier LBL information will be removed, a new LBL array with a location for each transponder will be defined, and the filtered SSBL positions will be set as the locations initial positions. The SSBL positioning will then be stopped.

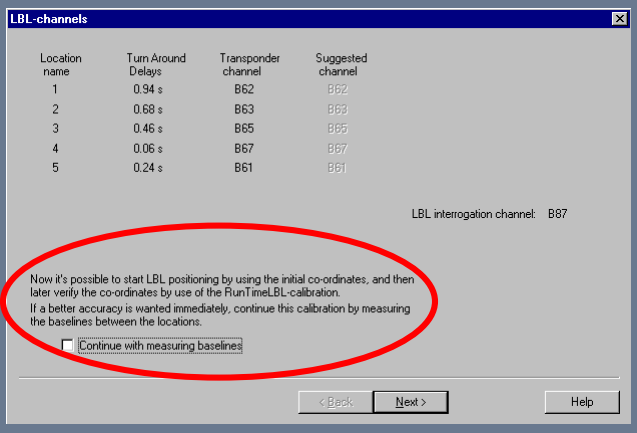
LBL CHANNELS



Press the button "Change to suggested channels" to execute the changes. If the changes are done the button and the comments above will disappear.

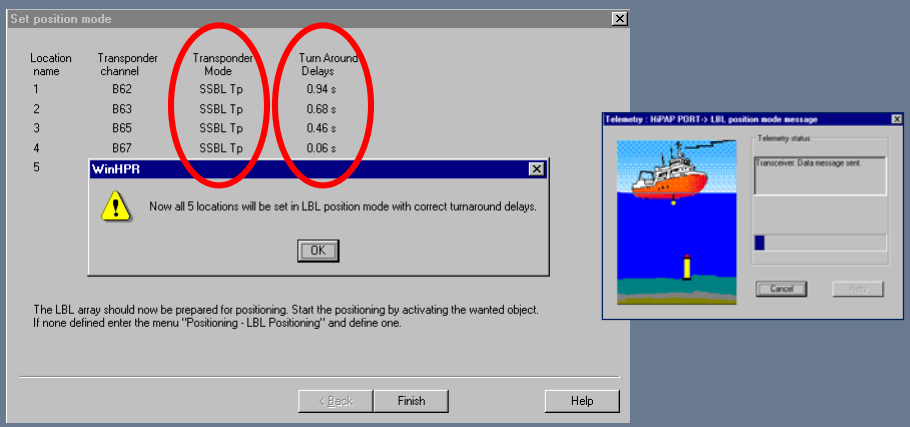
The second page in the LBL-calibration wizard is called "LBL-channels". It check that the transponder channels used are legal, a LIC channel is suggested and turnaround delays is suggested based on the initial co-ordinates. A LBL-array has some rules with channels used. First digit in all channels must be either even or odd, and the last digit must be different for all locations.

MEASURE BASELINES OR NOT



Before continue by pressing "Next" a decision about measuring baselines must be done. With the checkbox "Continue with measuring baselines" checked, the next page will be "Measuring baselines". If not checked the wizard will get you directly to "Set position mode".

SET POSITION MODE



When entering this page all locations (transponders) will be set in LBL position mode. This include information about LIC (the common LBL interrogation channel) and TAD (turn around delays).

ARRAY PREPARED FOR POSITIONING

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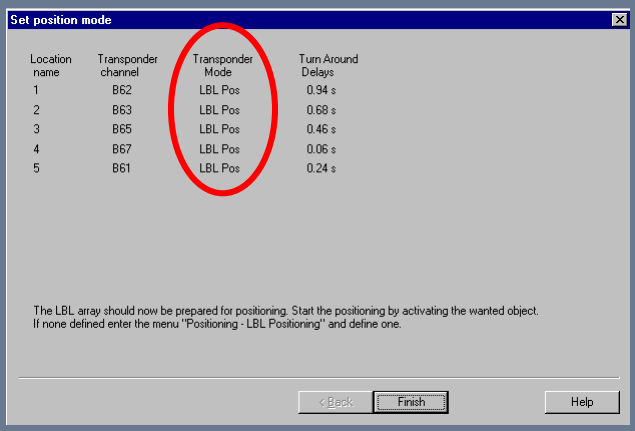
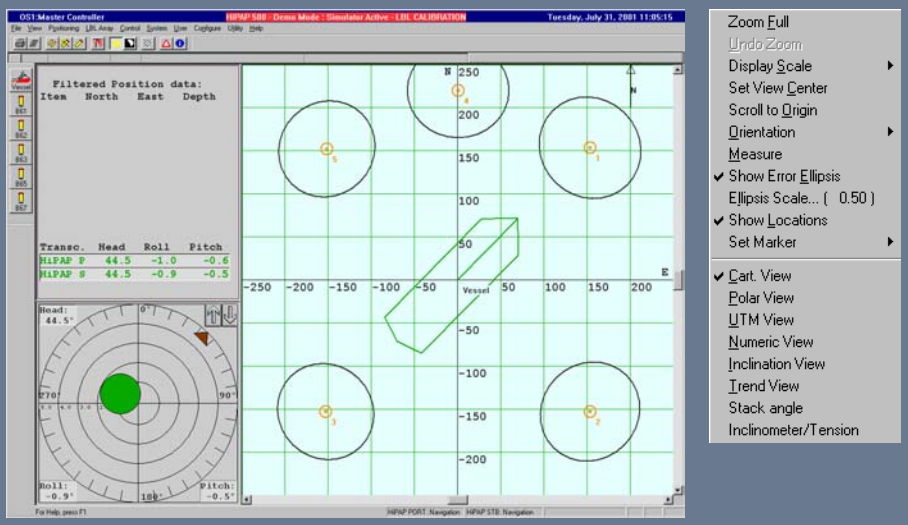
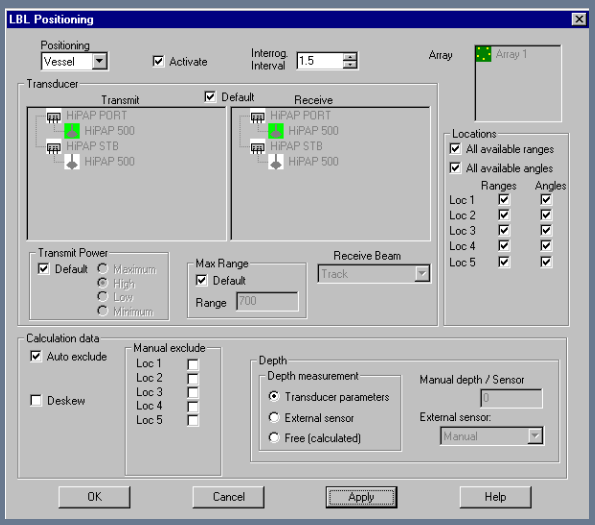


LOCATIONS AND ERROR ELLIPSIS

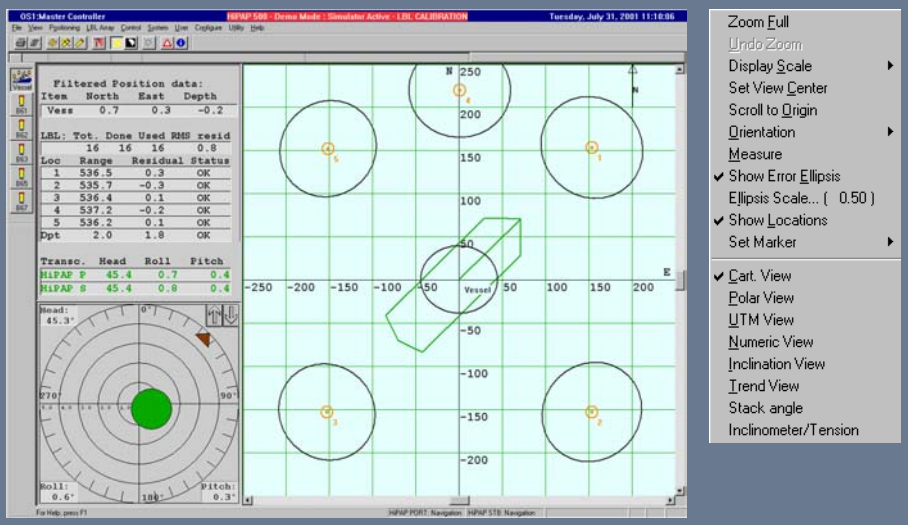
KONGSBERG



OPEN LBL POSITIONING DIALOG



LBL POSITIONING SCREEN DUMP



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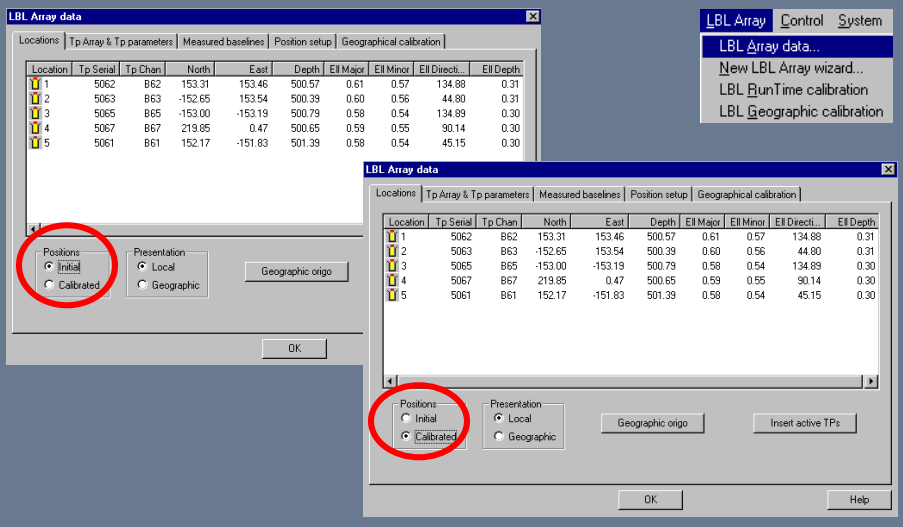
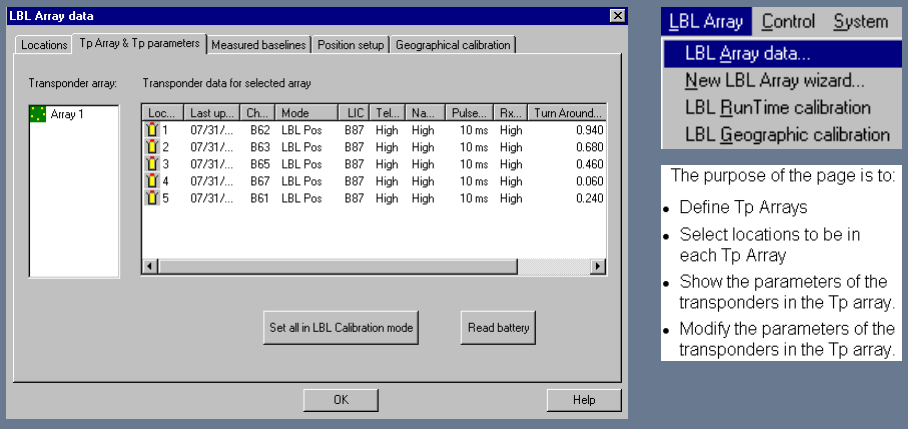
INITIAL AND CALIBRATED POSITIONS



Kongsberg Maritime

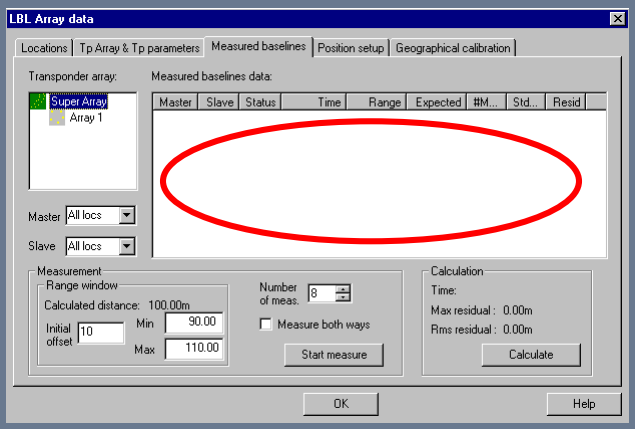
TRANSPONDER ARRAY PARAMETERS

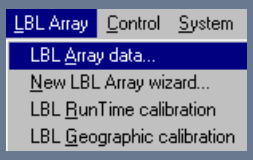


The purpose of the page is to:

- Define Tp Arrays
- Select locations to be in each Tp Array
- Show the parameters of the transponders in the Tp array.
- Modify the parameters of the transponders in the Tp array.

MEASURED BASELINES DETAILS



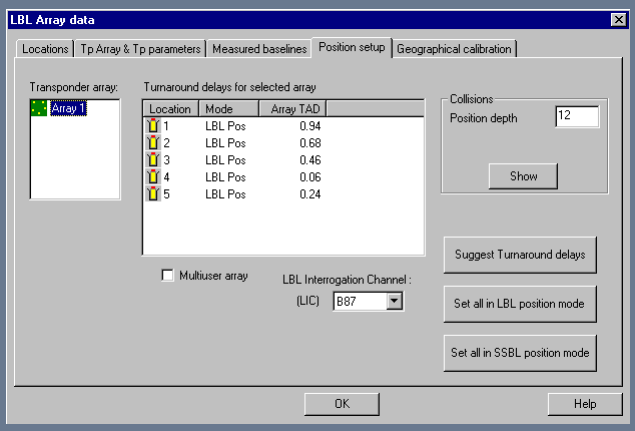


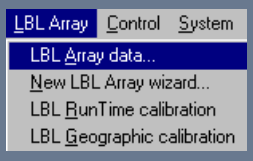
The purpose of the page is to:

- Show the baselines that are measured.
- Measure the baselines.
- Calculate the Calibrated positions of the locations in the LBL array.

A baseline is the line between two locations in the LBL array. It is measured by the transponders themselves. The communication between the transponders and the APOS is with telemetry.

POSITION SETUP

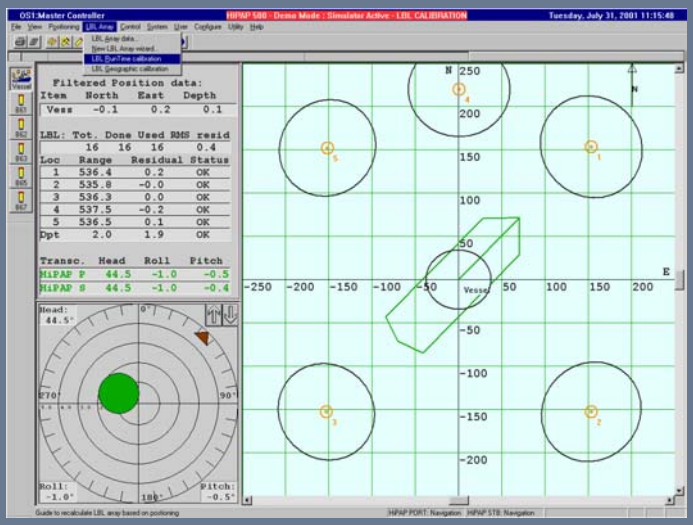




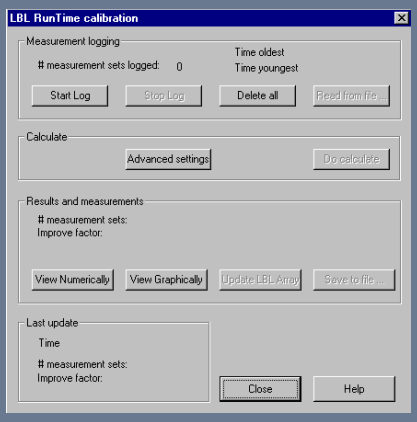
The purpose of the page is to:

- Show the mode of the transponders in the LBL array.
- Calculate and examine the turnaround delays to be used for the transponders in the LBL array.
- Set the common LBL Interrogation channel for the transponders in the LBL array.
- Modify the mode of the transponders in the LBL array.

OPEN LBL RUNTIME CALIBRATION



START AND STOP LOGGING



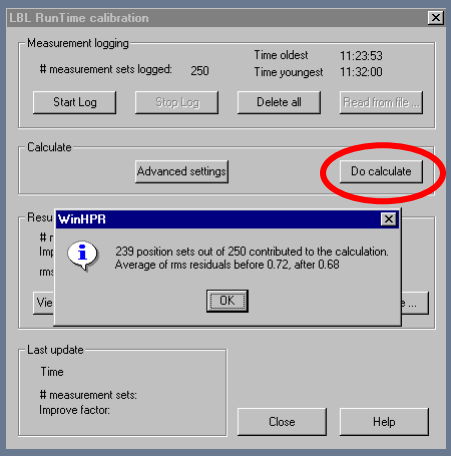
The Start Log button is enabled when the vessel is positioning in LBL. Tick it to start the logging. Then the button is disabled, and the Stop Log button is enabled.

The number of logged measurements is displayed. It is incremented each time a new measurement set is logged. The measurement set consists of the calculated LBL position of the vessel and all the LBL measurements. If one or more of the LBL measurements are missing, the set is not logged. If the rms of the residuals is greater than 25, there is obviously something fundamentally wrong with either the measurements or the APOS settings, and the measurement set is not logged. These are the only quality requirements for a position and its measurements to be logged.

There is an upper limit of the number of measurement sets to be logged in memory. The limit is set equal to 250. Then the oldest measurement set is deleted when a new measurement set is logged. The clocks of the youngest and the oldest measurement sets are displayed.

When the logging is started, it continuous until turned off, also when the dialog is not displayed. It enables you to, at any time, to do a calculation with the last 250 measurement sets. We do, however, not recommend to have the logging on all the time when using the APOS as a DP reference. When you request the APOS to calculate the suggested positions, the calculation will last for almost half a minute, and in this interval APOS will not deliver new positions to the DP. We therefore recommend the logging of the measurement sets and the calculation of the suggested positions to be done only when you are concentrated on the topic.

CALCULATE BUTTON



This button is enabled when there is at least one measurement set in memory, and the logging is turned off. When you tick the button, new positions for the locations in the LBL array are calculated. The calculation lasts for approximately half a minute. Then a message box with a short summary is displayed, as

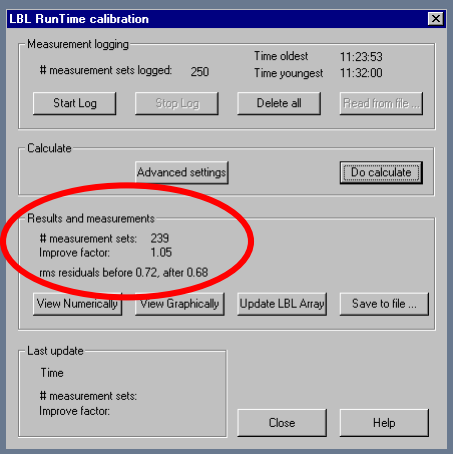
Tick the OK button to acknowledge. In the interval from you tick the Calculate button and till you acknowledge the message box, the APOS does not calculate new LBL positions. Therefore you must not do the calculation for a run time calibration when the positions from the APOS are used by the DP and the DP does not have another stable position reference.

As you see in the message box, some of the 250 measurement sets are not used in the final calculation. They are automatically excluded by the APOS because they do not fit well with the rest of the measurement sets.

Filtered Position data:

Item	North	East	Depth
Vess	-0.4	-0.1	0.1

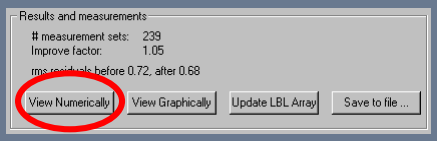
MEASUREMENT RESIDUALS



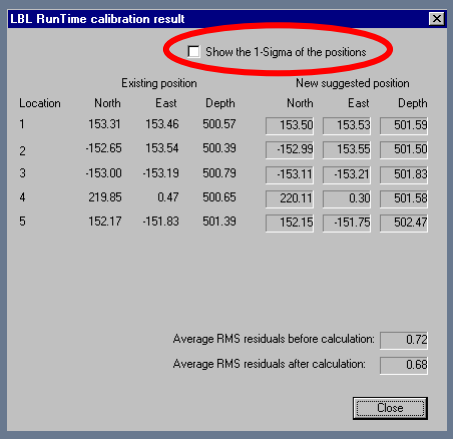
For each LBL calculation of the vessel position, APOS calculates the residuals of each measurement. Then APOS divides each residual with the expected accuracy of the measurement, and calculates the rms (root mean square) of these quotients. This number is presented on the APOS screen for each calculation. A number less than 1 indicates that the measurements are more accurate than expected.

In the calculation for the run time calibration, APOS calculates the average of the rms values as they were calculated when the measurements were used the first time with the existing LBL locations position. It is called "Average of rms residuals before". When the run time calibration is done, new positions for the locations are calculated. They shall match the measurement sets better than the existing positions.For each measurement set, APOS calculates the vessel position based on the locations new position, and it calculates the rms value of the residuals. The average of the new rms values is named "Average of rms residuals after". When this number is much less than the before value, the new positions match the measurements significantly better than the existing positions do.

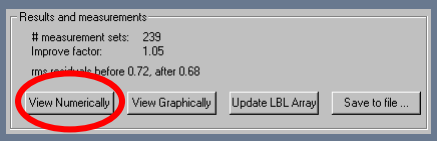
RESULT OF CALCULATION - POSITIONS



The existing positions are the calibrated positions of the transponders, as they are used by APOS. The new positions are the ones calculated in the run time calibration. The average of the rms values are as explained in the previous section.

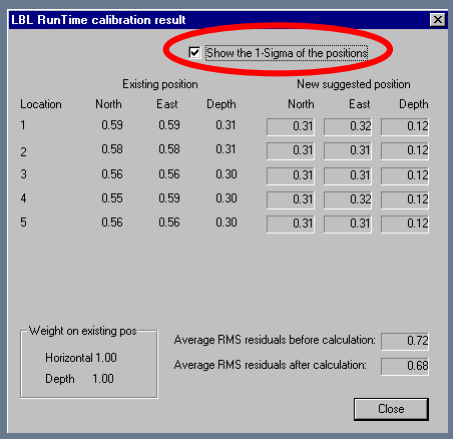


RESULT OF CALCULATION - 1 SIGMA OF POSITIONS

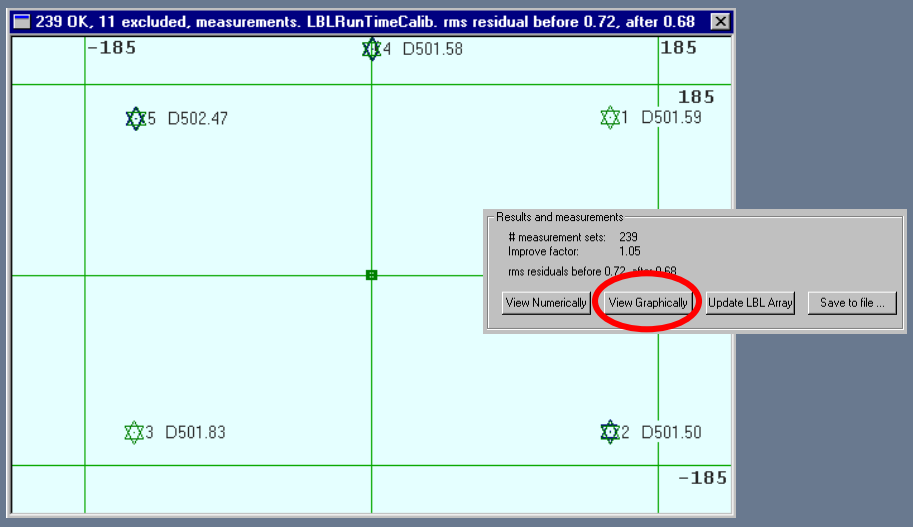


The 1-sigma values tell the uncertainty of the positions. The values for the existing positions are directly derived from the error ellipses of the locations in the LBL-array. When these values are small, the existing positions contribute more to the suggested positions than when they are large. The 1-sigma values of the suggested positions are always less than the values for the existing positions, because APOS uses both the existing positions and the measurement sets to calculate the suggested positions.

Two weight factors are shown in the lower left corner. They are explained in the chapter with the Advanced information. The default value is 1, which shall normally be used. You must be logged in as user Service to change these factors from their default values.



GRAPHICALLY PRESENTATION OF MEASUREMENTS



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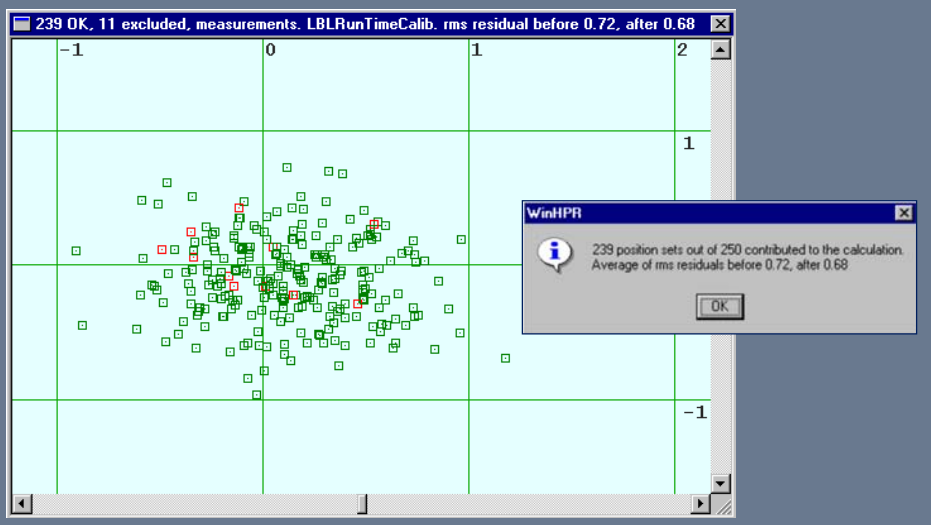
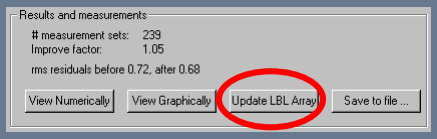
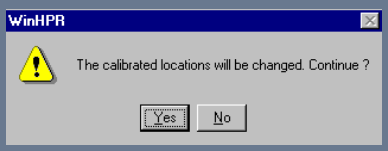
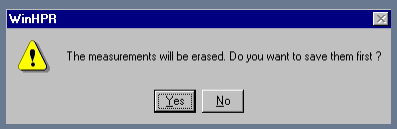


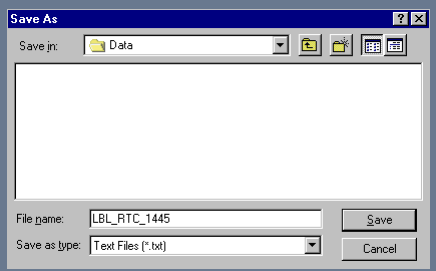
UPDATE LBL ARRAY WITH SUGGESTED POSITIONS



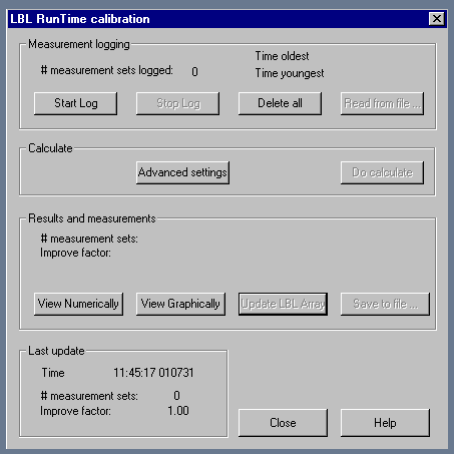
This button is enabled when you have done a calculation. It enables you to replace the co-ordinates of the LBL array in APOS with the suggested positions. If the vessel positioning is active, the positioning is automatically deactivated before the change of the co-ordinates, and then activated again after the change.







LAST UPDATE INFORMATION



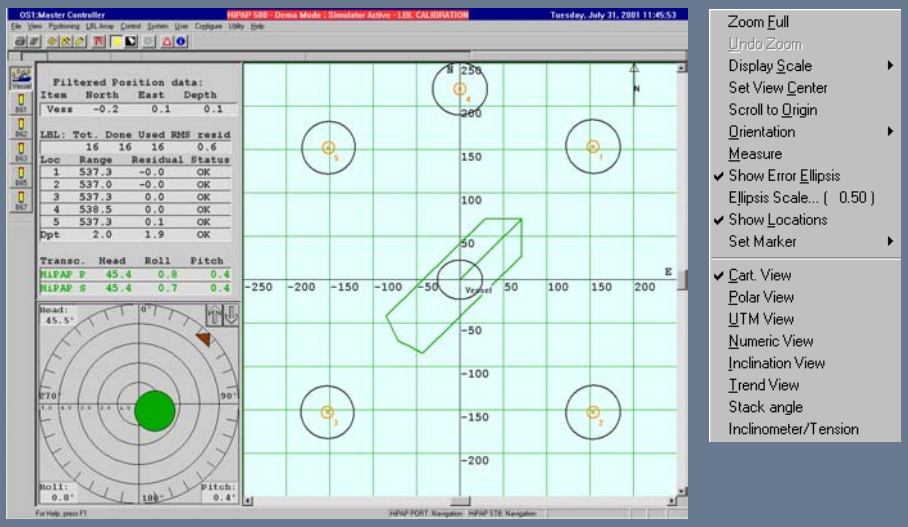
The **Last Update field** in the lower left corner of the dialog contains information about the last update. This information is displayed in the dialog till the next power on of the APOS. The new positions of the LBL array will be remembered also after the next power on of the APOS, but APOS will no longer display the information that they are derived from a run time calibration.

When the Update LBL array button is ticked, the measurement sets in memory are deleted. If they are not saved to a file, APOS asks if you want to do so before doing the update.

The recommended procedure for the logging, calculation and the update is:

1. Start the logging
2. Wait till 250 measurement sets are logged. Then stop the logging.
3. Do a calculation.
4. Examine the results, and check that the improvement with the suggested co-ordinates is significant. As a rule of thumb, the improvement is significant when the improvement factor is greater than 1.5. Then you are recommended to continue with the next steps.
5. Save the measurements to a file.
6. Update the LBL array by ticking the Update button.

LBL POSITIONING



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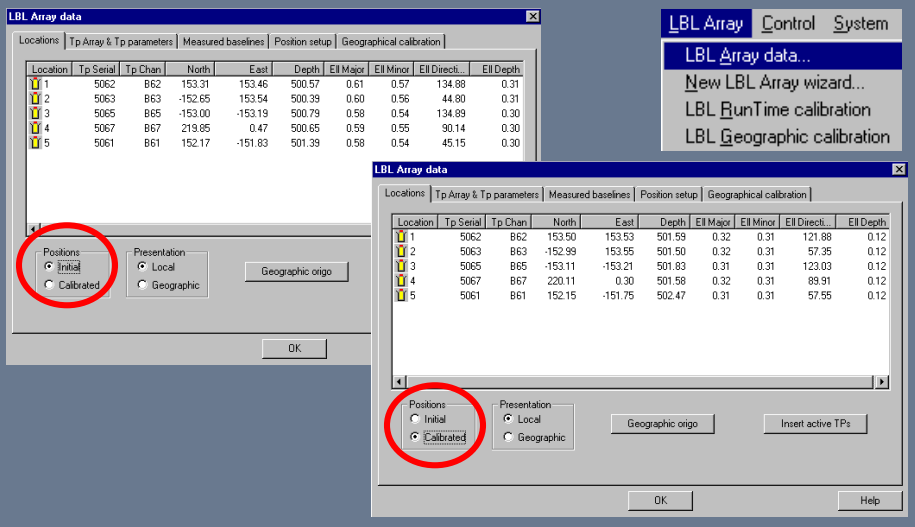
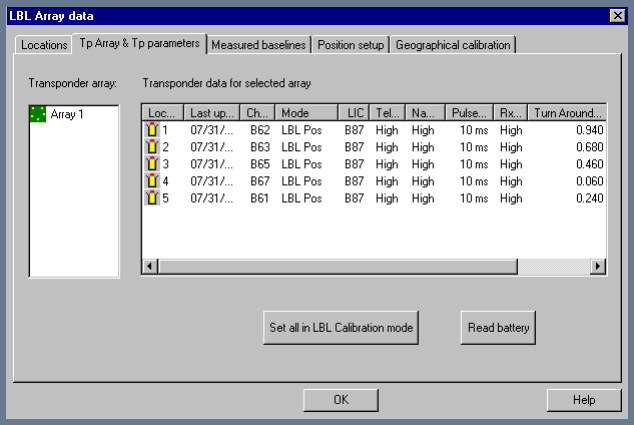
INITIAL AND CALIBRATED POSITIONS



TRANSPONDER ARRAY PARAMETERS



The purpose of the page is to:

- Define Tp Arrays
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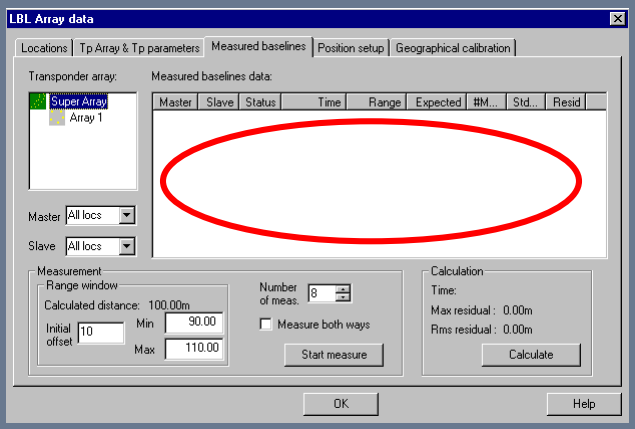
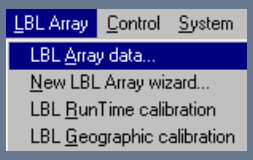
MEASURED BASELINES DETAILS





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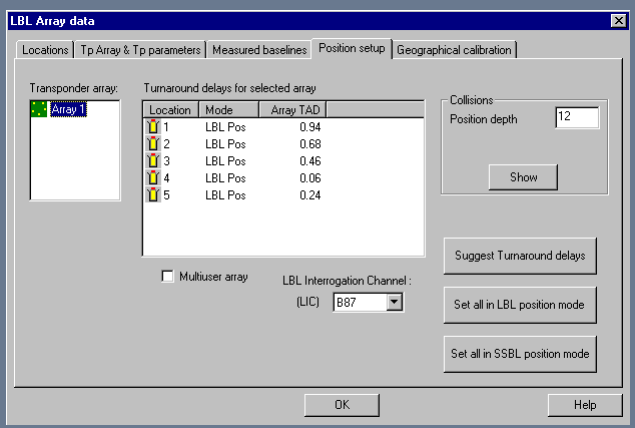
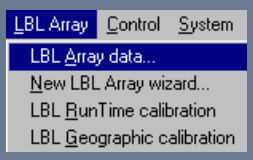
POSITION SETUP





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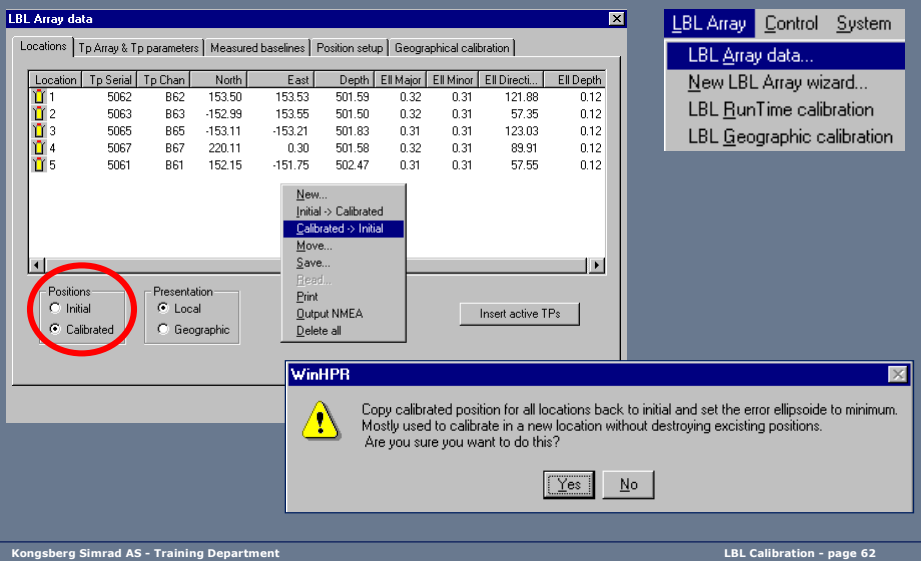
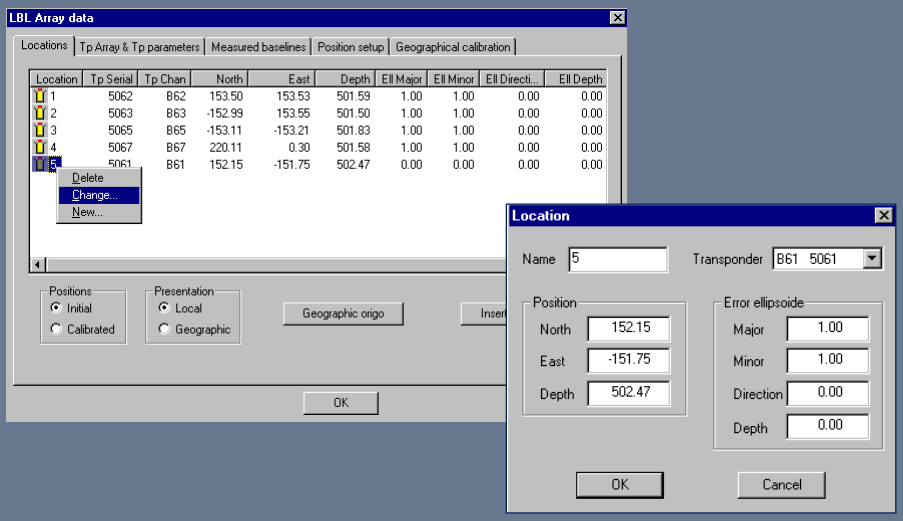
OPEN LBL ARRAY DATA DIALOG

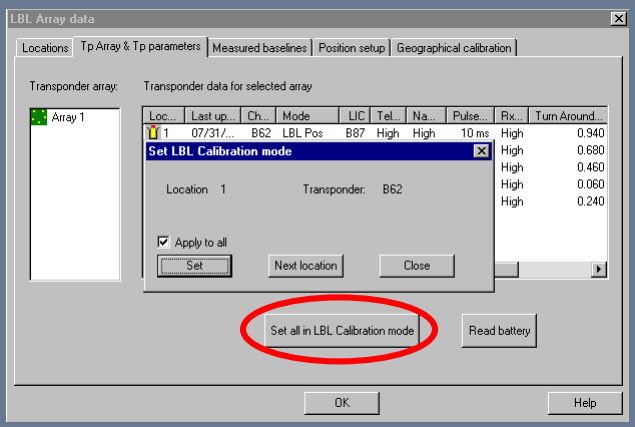
CALIBRATED TO INITIAL POSITIONS



CHANGE ERROR ELLIPSIS FOR ALL LOCATIONS



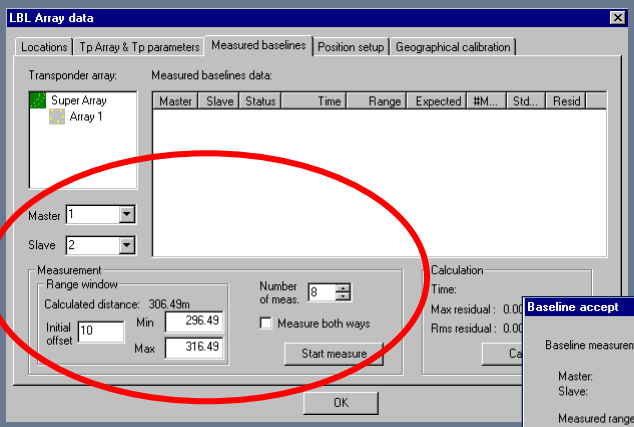
LBL CALIBRATION MODE

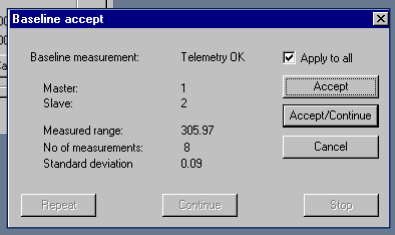


Set all in LBL calibration mode button
This is a short cut to get all locations set to LBL calibration mode. Each location in the defined array is set in LBL calibration mode by use of telemetry, it will start on the first location and then the next will follow.

The read battery button
When you press the Read battery button, the Tx ping counts for the transponders are read with telemetry. The **Last Update** column is updated with the date.

BASELINE MEASUREMENTS





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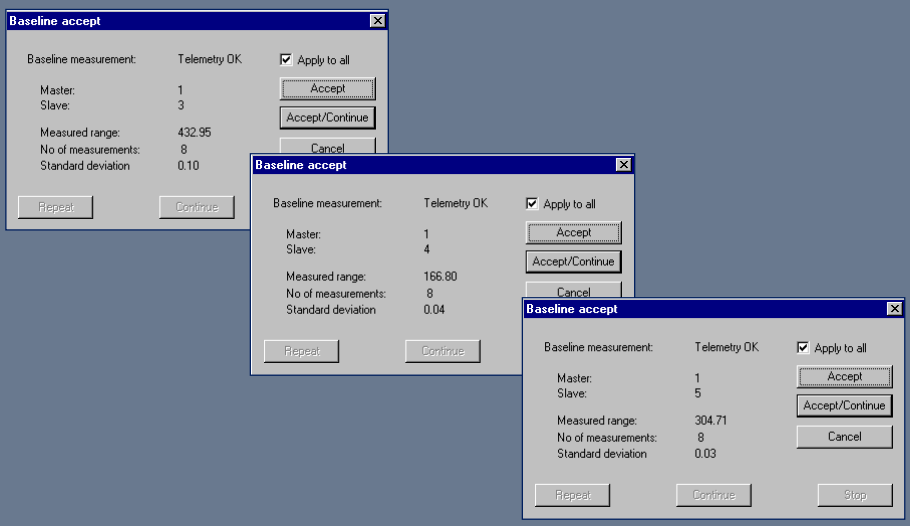
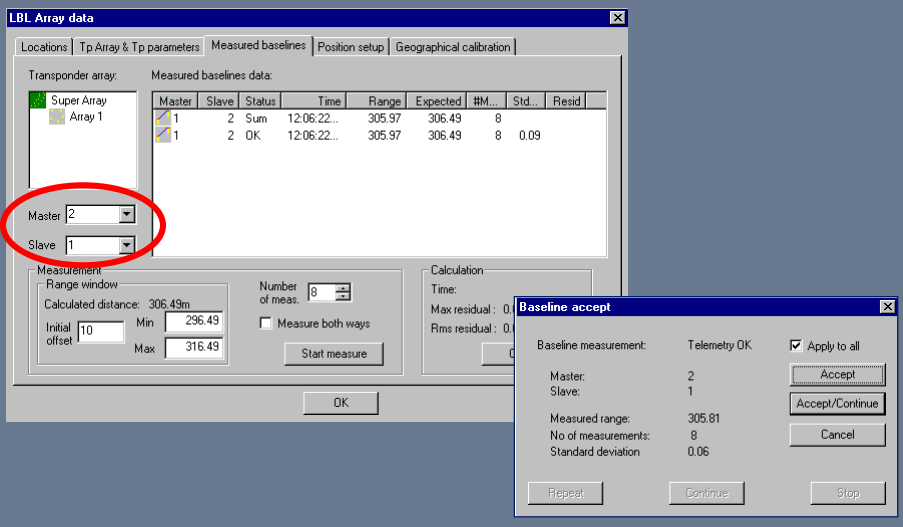
Kongsberg Maritime

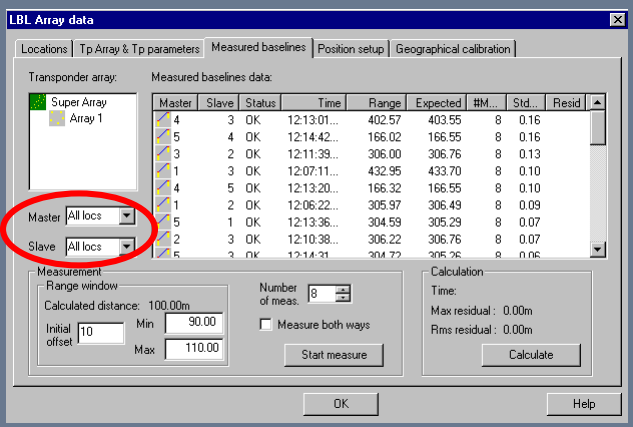
BASELINE MEASUREMENTS



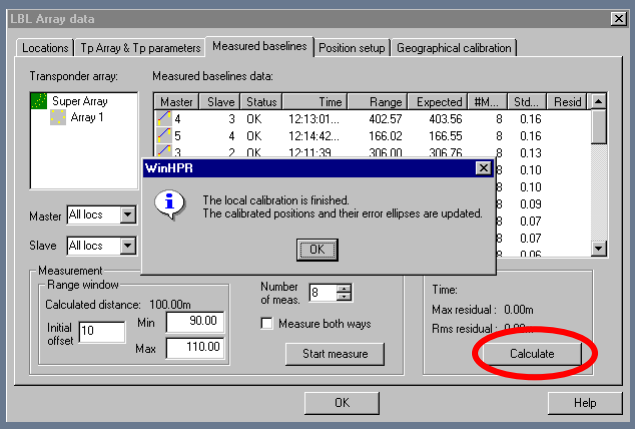
BASELINE MEASUREMENTS



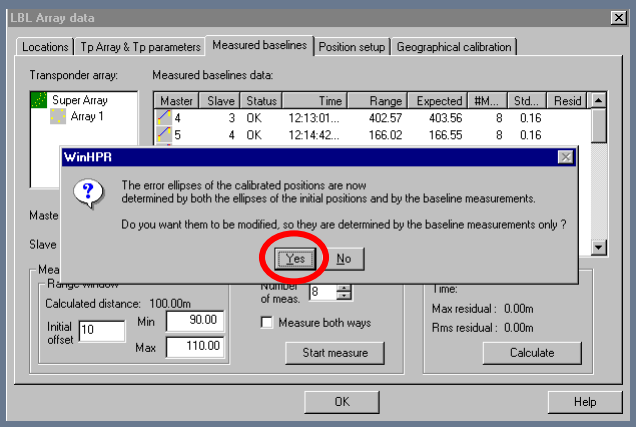
BASELINE MEASUREMENTS



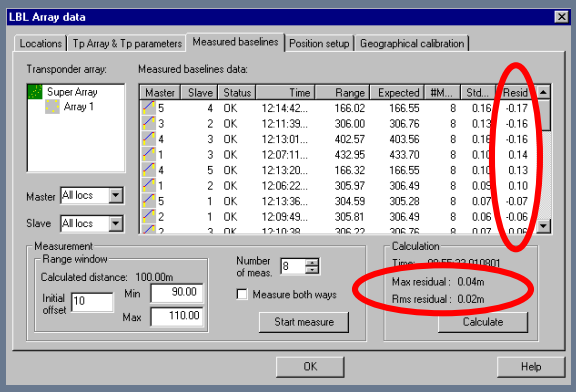
CALUCLATE CALIBRATED POSITIONS



DECIDE ERROR ELLIPSE CALCULATION METHOD



CALIBRATED POSITIONS



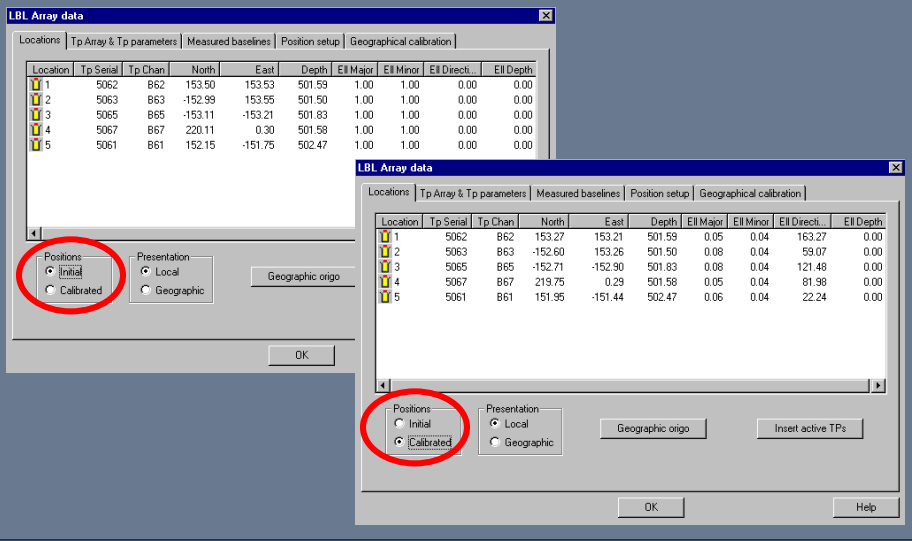
When the local calibration is done, APOS calculates the residual of each measurement set. (The residual is the difference between the baseline measurement and the distance between the calibrated positions of the locations).

The maximum value and the rms value of the residuals of the Sum elements are displayed in the page just above the Calculate button

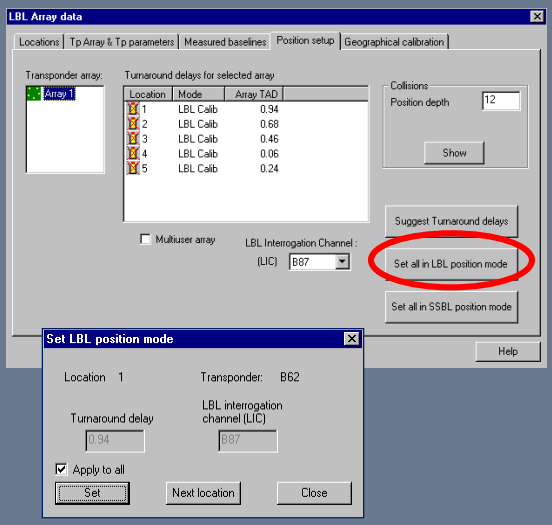
The rms is the root of the mean of the squares. It may be regarded as an average value in which the greatest values contribute more than the smaller ones. It is of course best to have these two values as small as possible, but it must not be a goal in itself for two reasons.

1. The more baselines that are measured, the more overdetermined the calculation of the local calibration is. Then it is more difficult for the algorithm to find positions that match all the measurements, and the residuals will tend to increase. But it is positive for the expected accuracy of the calibrated positions to have as many as possible of the baseline measured. We must therefore not exclude or delete all the measurement sets of a baseline to get small residuals. It should only be done when we know for sure that the Sum element of a baseline measurement is wrong.
2. The maximum and rms residual values are in metres. A big residual of a Sum element does "less harm" if the StdDev is big too. Then the weight on the baseline measurement is small, and it will not destroy the result when more thrusty measurements are available.

INITIAL AND CALIBRATED POSITIONS



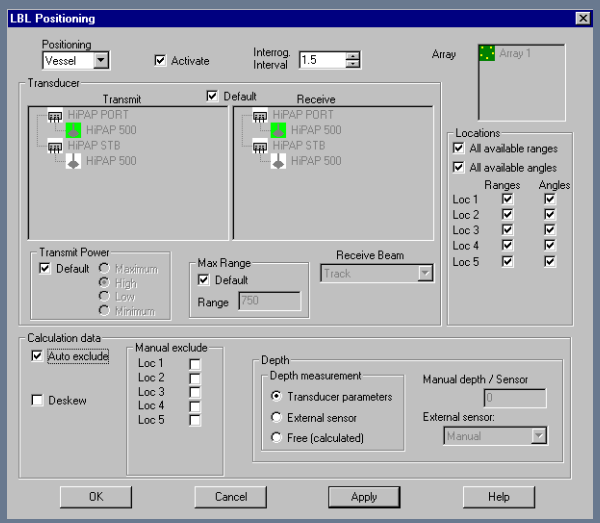
LBL POSITION MODE



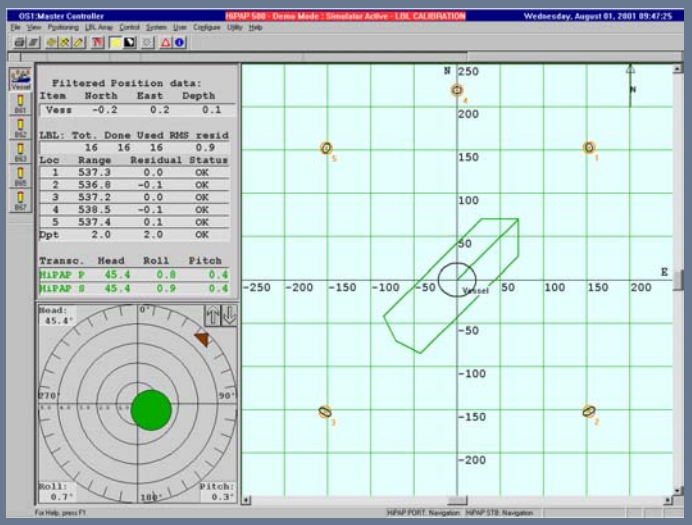
The turnaround delay and the LIC is transferred to the transponder when its mode is set to LBL positioning.

When the mode of the transponder is LBL positioning, and the LIC and the turnaround delay of the transponder are as planned for the array, the red cross displayed above the transponder symbol is removed, indicating that the transponder is ready for LBL positioning. The Array turnaround delays are selected so that the replies from the transponders are not received simultaneously at the transducer. A simultaneous reception will degrade the accuracy of the reception, especially when both the ranges and the SSBL directions are measured. We avoid simultaneous reception by choosing different turnaround delays for the transponders. The turnaround delays my be set between 0.06 and 5.10 seconds in intervals of 0.02 seconds. The separation between the turnaround delays should be big enough to avoid collisions, but not more than necessary due to its effect on the position update rate.

ACTIVATE LBL POSITIONING



LBL POSITIONING SCREEN DUMP



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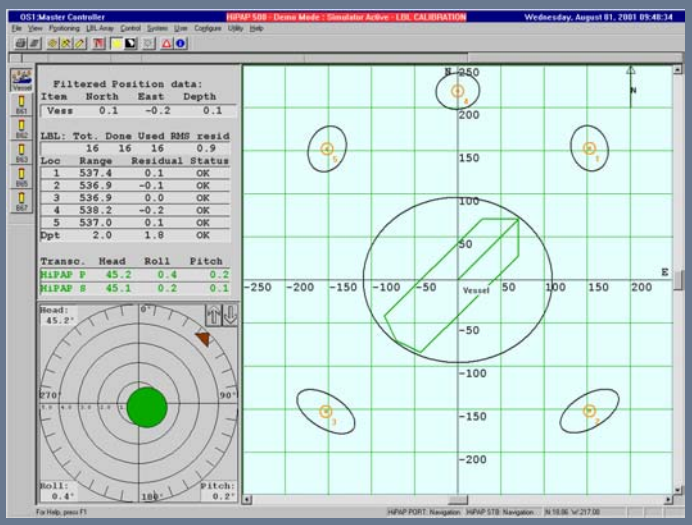
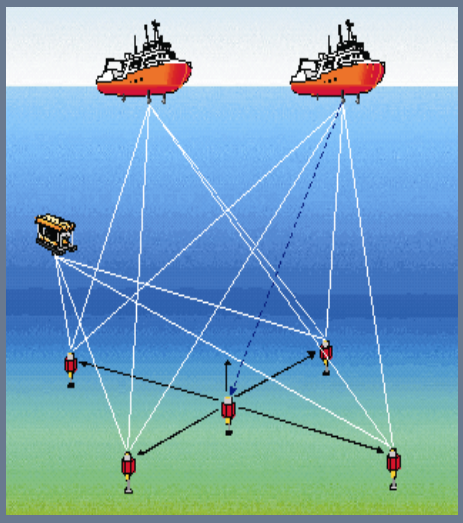
LBL POSITIONING SCREEN DUMP



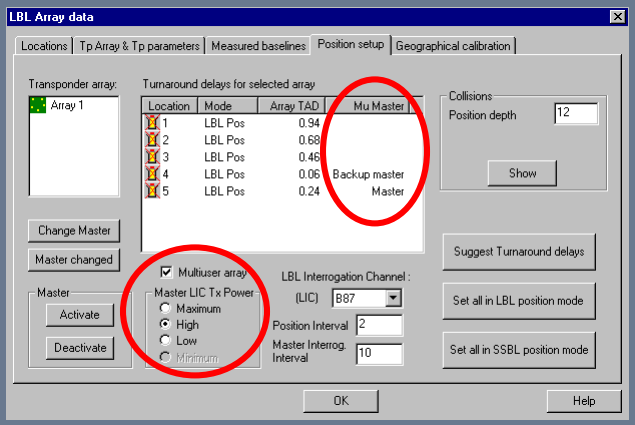
MULBL SETUP

In a multi user long base line array one extra transponder is normally included in the LBL array

The local calibration will be done as with a normal array



MASTER AND BACKUP MASTER TRANSPONDER



Master LIC Tx Power
This field specifies the power to be used by the Master when interrogating the slaves on the LBL Interrogation Channel. Any changes must be updated to the transponder by setting it in LBL position mode. Even if the Master already is in MuLBL positioning mode you still need to send the LBL Position mode command.

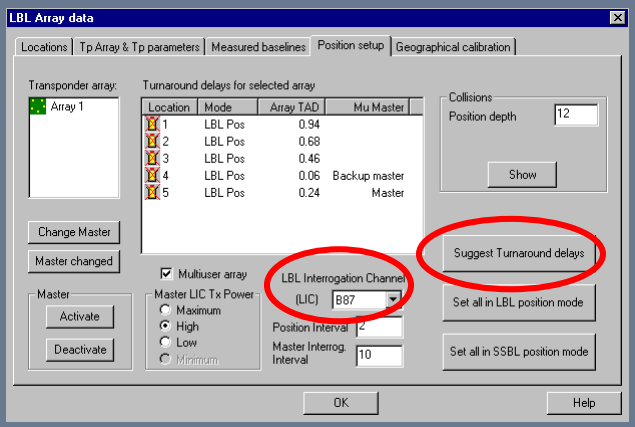
Select as master

This command causes the selected transponder to be the master. It must be selected before the turnaround delays are calculated/decided.

Select as backup master

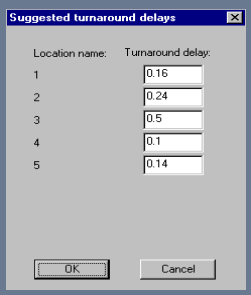
It's possible to prepare a location/transponder as a backup master for MuLBL. The transponder must be defined as a location and calibrated as all the other transponder. By the context menu it's possible to select it as a backup master. The selection must be done before *Suggest Turnaround delays* are pressed, because the suggest calculation take care of the different ranges from master/backup master. When a backup master is defined the buttons *Change Master* and *Master changed* appear. Note that the backup master will not be used in the positioning, the transponder should be in SSBL Positioning mode.

TAD & LIC

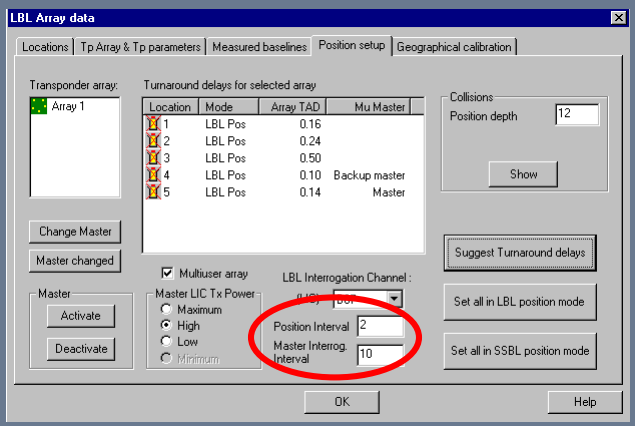


Suggest Turnaround delays

The turnaround delay for each transponder is different for MuLBL contra normal LBL. In MuLBL the turnaround delay depends also on the range from master (and any backup master) to the actual transponder. Press this button after calibration of array and after each change in Master/Backup master.



POSITION INTERVALS



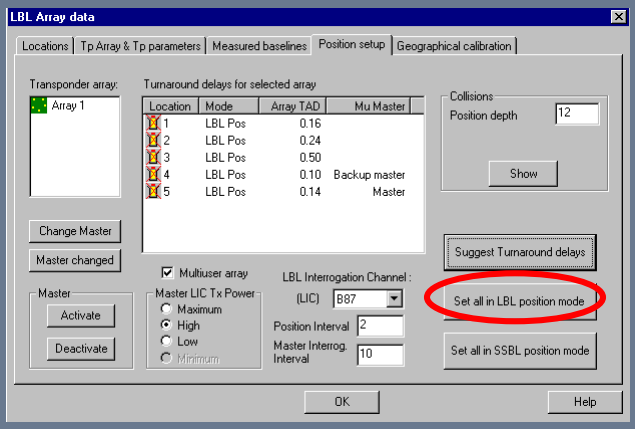
Position Interval

This is the interval in seconds between the transmission of the navigation pulses from the transponders to the HiPAP/HPR system. It is used by both the Master transponder and the slave transponders. When OK pulses are received from the transponders, the HiPAP/HPR system will calculate a new position with the position interval.

Master Interrog. Interval

This is the interval in seconds between the Master interrogations of the other transponders. APOS will always adjust it to be a multiple of the Position Interval.
If the quotient between the master interrogation interval and the position interval is more than 32, APOS does not accept the parameters.

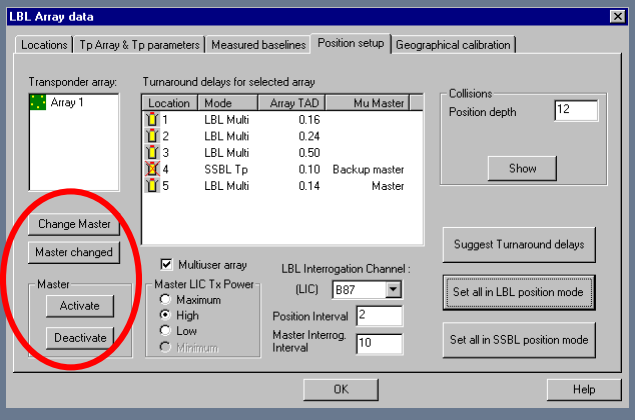
MULBL POSITION MODE



Set all in LBL position mode

When this button is pressed all transponders will by telemetry be set in correct position mode, that includes information about turnaround delay, LBL interrogation channel, position interval and Master interrogation interval. For Master it also contains information about Master LIC Tx Power.

ACTIVATE MASTER TRANSPONDER



When the multiuser parameters are sent to the transponders on telemetry, the array is ready to be activated. Just press the **Activate** button, and a message is sent on telemetry to the transponder selected as the master with request to start the positioning sequences.

The master continues to do the positioning sequences until stopped by a Deactivate message. That message is transmitted from the HiPAP/HPR system when you press the **Deactivate** button.After having sent that message, a standard Read parameters message is sent to the master. When deactivated, the Master stops sending the interrogations to the slaves. But the slaves will continue for some time to transmit their navigation pulses. They are free-running, and do not know whether the missing interrogations are caused by acoustic problems or a deactivation of the master.

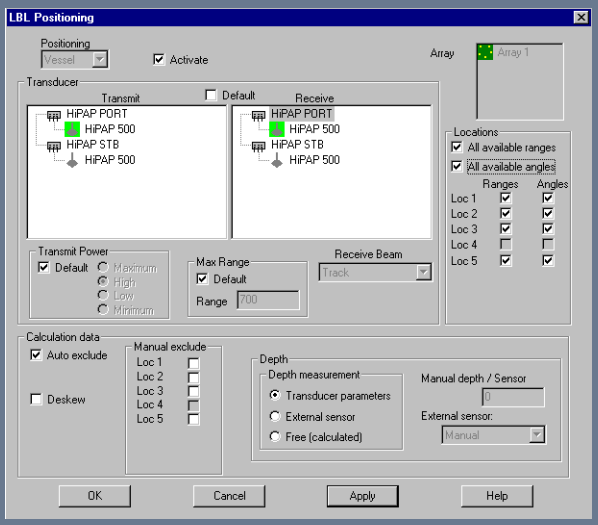
Change Master

When a backup master is defined, this button appears. This command will by telemetry commands Deactivate the current master, set the current master in SSBL Positioning, set the backup master in MuLBL position mode, activate the backup master and at last switch master and backup master. This only to be used once for the MuLBL array, for other system using the same MuLBL array they should use the *Master changed* button.

ACTIVATE MULBL POSITIONING

The MULBL positioning of the vessel is started in the LBL Positioning dialog, just as standard LBL. The HiPAP/HPR system knows that the LBL array is set up as a multiuser array, and will therefore be passive and just wait for the transponder replies. You are allowed to start the positioning before the Master transponder is activated, but, of course, without receiving any replies.

The slave transponders will wait until they have received some OK interrogations from the Master before they start to transmit their navigation pulses. It can therefore take some time before the replies are received from the slaves.

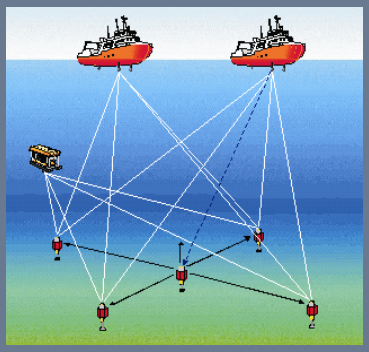


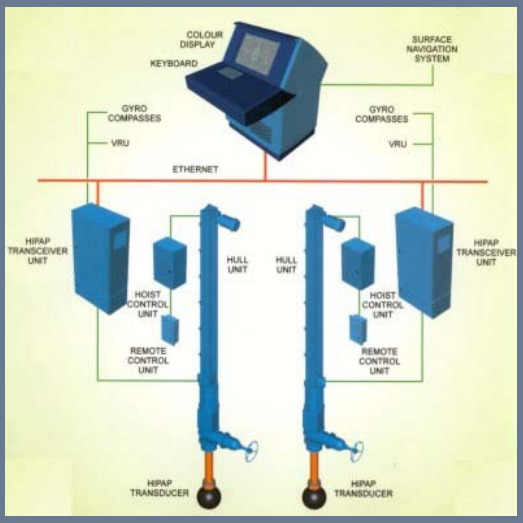
MULBL POSITIONING SCREEN DUMP

DUAL MULBL SETUP

The vessel has two HiPAP® transceivers and transducers

You want each HiPAP® to calculate a MULBL position

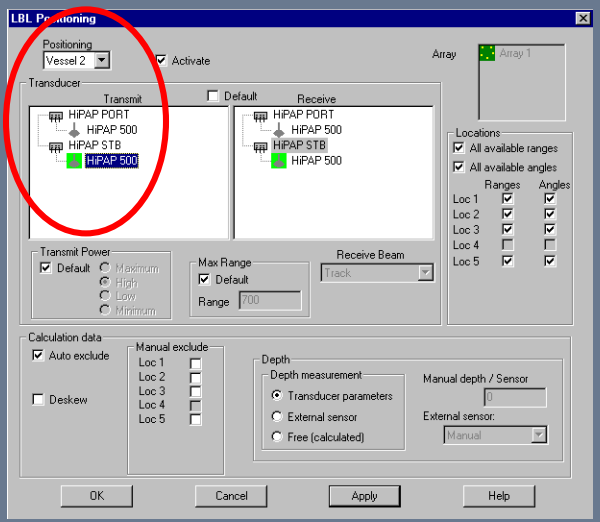




ACTIVATE DUAL MULBL POSITIONING

The MULBL positioning of the vessel is started in the LBL Positioning dialog, just as standard LBL. The HiPAP/HPR system knows that the LBL array is set up as a multiuser array, and will therefore be passive and just wait for the transponder replies. You are allowed to start the positioning before the Master transponder is activated, but, of course, without receiving any replies.

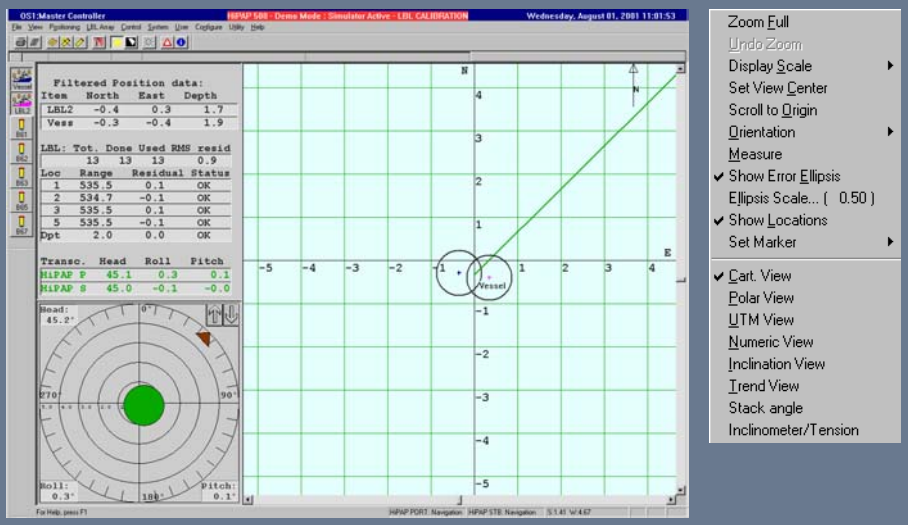
The slave transponders will wait until they have received some OK interrogations from the Master before they start to transmit their navigation pulses. It can therefore take some time before the replies are received from the slaves.



DUAL MULBL POSITIONING SCREEN DUMP

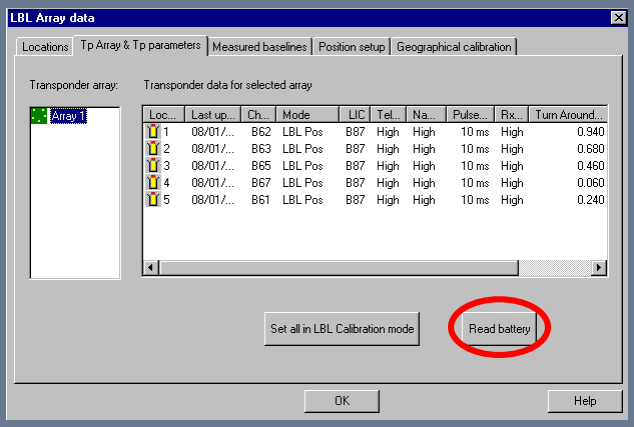
Kongsberg Maritime

DUAL MULBL POSITIONING SCREEN DUMP



RECOVER ARRAY TRANSPONDERS

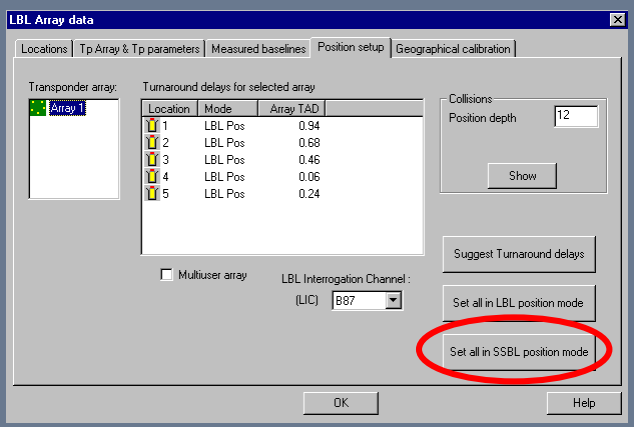
Read battery status for all transponders in the array



RECOVER ARRAY TRANSPONDERS

Stop LBL/MULBL positioning

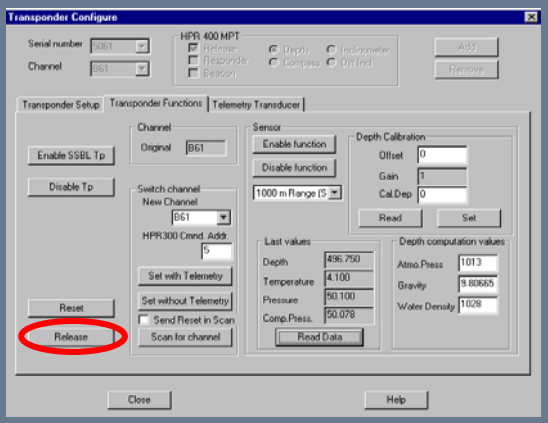
Set all transponders in SSBL mode

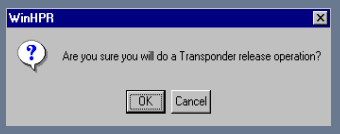


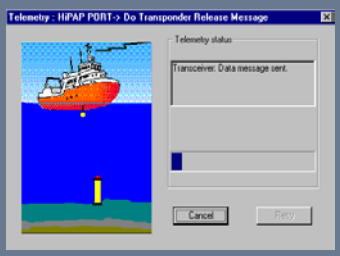
RECOVER ARRAY TRANSPONDERS

Release the transponders one by one

Monitor the position as it floats up to the surface - it might drift off







RECOVER ARRAY TRANSPONDERS