Quality check -
historical hydrological data in Angola

Status by 2004

Nivel de Agua (water level)
Mediçao de Caldal (discharge measurements)
Curva de vaçao (rating curves)
Caudais medios diarios (daily mean water flow)

Norwegian Water Resources and Energy Directorate
2004

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Quality check - historical hydrological data in Angola

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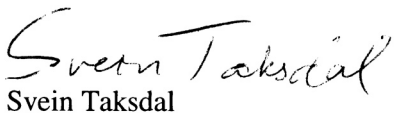
Table of contents

Preface

A cooperation agreement between The Norwegian Agency for Development Cooperation (NORAD) and The Norwegian Water Resources and Energy Directorate (NVE) states that NVE shall assist and advise NORAD and the Norwegian Ministry of Foreign Affairs within the framework of NVE's competence in management of water and energy resources. One project in this cooperation is the National Water Sector Management (NAWASMA) project, which was started in Angola in 2002. The NAWASMA project is an institutional cooperation between the National Directorate of Water (DNA) in Angola and NVE. A main objective in this project is to strengthen DNA in the regional cooperation on water resources.

Institution and capacity building within hydrology is an important part of the NAWASMA project. Reliable and long series of historical hydrological data is a prerequisite for good water governance. The pre-war hydrological data in Angola are studied and checked. Recommendations for further work are given in this report.

Oslo, December 2004



Svein Taksdal

Acting director, Hydrology department

Executive summary

Angola is in a situation where proper water development planning is practically impossible. Lack of water data in the national database and uncertainty on the quality of historical water data in archives and in the database is the main reason.

A rapid water resources and water use assessment of Angola, is Activity C of the "National Water Sector Management" (NAWASMA) project, carried out since 2002 as institutional co-operation between the Angolan National Directorate of Water, DNA (Direcção Nacional de Águas) and the Norwegian Water Resources and Energy Directorate, NVE. The project and its activities cover the whole of Angola.

Activity C needs a quality check of data as an important part of its fundament. The mapping of Angolan water resources and water use in activity C is planned as a temporary (rapid) tool for NAWASMA and DNA.

Reports generated from the database show that 1965 – 1975 is suitable to describe the main Angolan data collecting period. This is also described in the report "HYDATA v4.2 training course and database upgrade" (Centre for Ecology & Hydrology, March 2003). **The lack of discharge measurements after 1975 is important to notice.**

In 2002 Angola had around 200 historical hydrological stations registered, - 1974 being a peak year with 181 stations operating. In the quality check process around 50 stations were excluded by the experience of Mr. Paulo Emilio Mendes. He is the only available person who has been working with the stations and hydrological data before 1975.

Basic data are water level and discharge measurements. The water level data are daily values, in some cases a daily reported value from an observer and in other cases a value from a limnigraph (as far as I could see the approximate mid day value from the water level graph). We do not have daily mean values.

The historical discharge measurements studied are well done – current meter "multi-point" measurements following international hydrometrical "standards" at the time. The discharge was calculated by a graphical velocity-area method (ISO 748).

A lot of the stations seem to have **a change in their section control** connected to the annual heavy rain period. This leads to a need for frequent discharge measurements and frequent change of valid ratings (at some stations a new rating each year). The necessary fieldwork, i.e. frequent measurements, seems to have been done. A general feeling is that **the original** flow data **in the archives** reflect the necessary work to obtain good quality, but we are yet not able to conclude on this.

In general, the flow data **in the database** (as a product of the number of discharge measurements and the ratings **in the database**) **do not** reflect all the historical hydrometry that has been done. This has to be handled.

I soon discovered that the archives had more data than the database i.e. water level data, discharge measurements and original flow data. I found that this had to be handled first. A quality check on fragments of the real data collection seemed meaningless. A lot of data are simply not registered into the database.

In the quality check 20 stations were "completed" and 26 stations were prepared for further work by the end of my first visit at DNA. 129 stations were not yet studied! I use "completed" since most of the stations still may have more data, and still may deserve a closer study and more work.

A change of strategy was made before my second visit at DNA. We found it most valuable to study and prepare as many stations as possible for further work and the final D-MASS analysis. **By this report 125 stations are studied and prepared for further work.** 40 of these are studied only in the database (see annex 4, "Important notes").

Further work is needed. First of all we should complete the study of the 174 stations. There are still 49 stations to study and prepare for further work. **Then - step one must be to complete the registration of archive data into the database and to exclude stations from further work** (see chapters 3 and 4).

A recommended string of preparatory work – for each station – and following quality tests (a prescription for systematical approach) is presented in chapter 4.

Hydrometry done in Angola before 1975 is solid. The main inputs to the database so far have been water level data and discharge measurements. The strategy has been to convert the water level dataseries into flow series via new rating curves (made by the operator on software from HYDATA). Since we often find results from discharge measurements missing in the archive, I do not think that this is a complete strategy. Our new rating curves may be "less qualified" than the original curves. The archives often have complete original flow series. They should be introduced into the database as time series of original daily flow.

In the spreadsheet "Angola stations" (see annex 3) the 125 stations studied have got "a quality stamp". The stamps (OK, ok?, +, +/?, ?, bad? and BAD) are signs of hope between the D-MASS tested OK or BAD. Hopefully future work can benefit from these "stamps". **And the stamps are signs of quality by now for the "rapid" work in "Activity C" of NAWASMA.**

By now 24 stations are "completed" (**19 good** and 5 bad), **7** stations are nearly there (ok?), **48** stations seem very promising and should be there without too much effort (+), **5** stations seem promising but with a doubt (+/?), 33 stations are still full of questionmarks (?) and 8 stations seem very dubious (bad?). After the Versao A job with Cambambe, the total number of stations to handle is 174.

Further work should hopefully give more than 100 good stations. 79 stations are already on the positive side.

The quality check was to be carried out in close co-operation with personnel working on the NAWASMA project in Angola. The ambition was to train one person from the Angolan hydrology staff. This part of my work failed. There was an obvious shortage of personnel in the staff, which at the time led to priority problems. The language barrier is also relevant. The strategy to train the staff in English is important to continue, in the long term view. To train the staff in data interpretation, how to correct data and construct data for missing periods – and constructing rating curves – is, of course, most important.

The annual reports (Anuário hidrológico) from DNA are in some cases wrong and incomplete, the worst example being station 603004 – Queve – Cachoeiras da Binga, where the annual report for 1972-73 gives the annual runoff 13,1 l/s*km^2. Correcting the discharge measurements (wrong water level) and establishing a new rating curve gave the annual runoff 8,0 l/s*km^2.

The quality check of historical data, with completion and correction in data, is necessary to create a reliable planning platform (a reliable database). The "rapid" work done now, due to immediate needs, should be continued by DNA. The finally qualified database should later be used to re-calculate the Angolan renewable water resources.

The work of transferring data from the archives into the database is necessary to make an efficient and complete quality control possible - and **the only way** that Angola can get a proper water management platform **valid for today**.

The hydrological data period 1965 – 1975 will be the fundament for all Angolan planning of water use, environmental water protection, and protection against floods and for answering hydrostatistical questions - in any Angolan small brook or large river - the next 20 years.

1. Introduction

A rapid water resources and water use assessment of Angola, is Activity C of the larger "National Water Sector Management" (NAWASMA) project, carried out since 2002 as institutional co-operation between the Angolan National Directorate of Water, DNA (Direcção Nacional de Águas) and the Norwegian Water Resources and Energy Directorate, NVE. The project and its activities cover the whole of Angola.

The potential of renewable water resources of Angola is not known with sufficient accuracy, mostly due to lack of data. Angola also needs data on total water use, water consumption, and future water demand.

Activity C needs a quality check of data as an important part of its fundament. The mapping of Angolan water resources and water use in activity C is planned as a temporary (rapid) tool for NAWASMA and DNA.

All of the hydrometric stations in operation at independence in 1975 have been abandoned during 27 years of civil war. This makes proper water planning practically impossible. The planned work will carry through a quality check of the Angolan **database** which consists of historical data from 1951 to 1988.

In order to check the quality of these data, it is necessary to work through a list of the most important hydrological stations in the different basins of Angola and to perform the following tests on each station (see Terms of reference in annex 1):

- Check the consistency between water level time series, gaugings (measurements) and ratings and flow time series for each station
- Evaluation of water level / flow relationship (rating curve)
- Check the consistency among comparable flow time series
- Check of catchment areas
- Double mass test of the data

The work on the quality check took place over eight weeks (October 12th – November 14th 2003 and March 10th – April 2nd 2004) at the office of the National Directorate of Water (DNA) in Luanda, Angola, resulting in the present report.

Valuable information was obtained through informal meetings with Mr. Paulo Emilio Mendes and Mr. Olav Osvoll at DNA, and daily by Mr. Miguel and Mr. Quipoco in the hydrological department's staff. An informal meeting with Mr. Gualberto, director of the Angolan Meteorological Institute (INAMET) was also very useful.

2. Findings

We have a main periode of data 1965 - 1975 from the historical Angolan national hydrometric network. The network by this period seems to give a reasonably good national coverage. Generally spoken, historical hydrometry in Angola seems to have followed time given international hydrometrical "standards".

The database and the archive, together have sporadic data 1951 – 1965. Potentially high quality data 1965 – 1975, covering all of Angola. And sporadic data after 1975. Reports generated **from the database** before October 2003 show that 1965 – 1975 is more suitable for describing the Angolan data collecting period than 1951 – 1980 (see Terms of reference in annex 1). This is also described in the report "HYDATA v4.2 training course and database upgrade" (Centre for Ecology & Hydrology, March 2003). **The lack of discharge measurements after 1975 is important to notice.**

The Angolan archive of historical hydrometric material consists of station by station red and black loose-leaf files.
The red file (usually one per station) contains all the history information apart from water level data and discharge measurements (pictures from construction period and flood events, construction drawings, area calculations and important historical notes – and, in some cases, basic data).
The black files (often two or three per station) contain the basic collected data, and/or printouts of data.

Basic historical data are water level and discharge measurements. The water level data are daily values, in some cases a daily reported value from an observer and in other cases a value from a limnigraph (as far as I could see the approximate mid day value from the water level graph).

I find that changes in 0-level (gauge datum) occur at some stations. This seems to have been done – some times to prevent negative water level values (in eroding secton controls), other times as a result of a disappearing watermark (stage gauge). It may have been flushed or eroded away. The change in 0-level may indicate a lack of benchmark. These changes should be given close attention.

The historical discharge measurements studied are well done – current meter "multi-point" measurements following international hydrometrical "standards" at the time. The discharge was calculated by a graphical velocity-area method (ISO 748).
The number of measurements per year varies a lot, but at many sites we find around 12 measurements a year. A monthly measurement may have been "a standard".

A lot of the stations seem to have **a change in their section control** connected to the annual heavy rain period. This leads to a need for frequent discharge measurements and frequent change of valid ratings (at some stations a new rating each year). The necessary fieldwork, i.e. frequent measurements, seems to have been done. A general feeling is that **the original** flow data **in the archives** reflect the necessary work to obtain good quality, but we are yet not able to conclude on this.

In general, the flow data **in the database** (as a product of the number of discharge measurements and the ratings **in the database**) **do not** reflect all the historical hydrometry that has been done. This has to be handled.

I find examples in the database on flow series which periodically consists of directly introduced original values and periodically by values from converted water level data. I would prefer two flow time series in such cases, to be able to make comparisons. After comparisons, the best data could be stored in a third complete flow time series.

The term "daily mean flow" (Caudais medios diarios) is used, but is not precise (see the comments on basic water level data above). This should be given attention comparing time series vs time series, and comparing Angolan hydrology data against Angolan meteorology data or hydrology data from neighbouring countries.

I soon discovered that the archives had more data than the database: Water level data, discharge measurements and original flow data. I found that this had to be handled first. A quality check on fragments of the real data collection seemed meaningless. A lot of data are simply not registered into the database.

In 2002 Angola had around 200 historical hydrological stations registered, - 1974 being a peak year with 181 stations operating. In the quality check process around 50 stations were excluded by the experience of Mr. Paulo Emilio Mendes. He is the only available person who has been working with the stations and hydrological data before 1975.

The total number of stations for the quality check after this was 156. 2 stations in the Cabinda provins and 10 so called "Versao A"-stations were not discussed during the exclusion process and therefore not left out of our list. 7 of the excluded stations were later found to have some data – or were located in areas without alternative stations – and should be considered taken back for further quality check. The volume for the quality check reached a total number of 175 "stations" – and my initial ambition was to check all of them.

The mentioned "Versao A"-stations should be defined and explained by Mr. Mendes. They should be compared to their "mother-stations" – and the best data should be kept under the standard station number. Then the Versao A station should be deleted. So far this job is done only for one Versao A, 60190802 Cuanza-Cambambe.

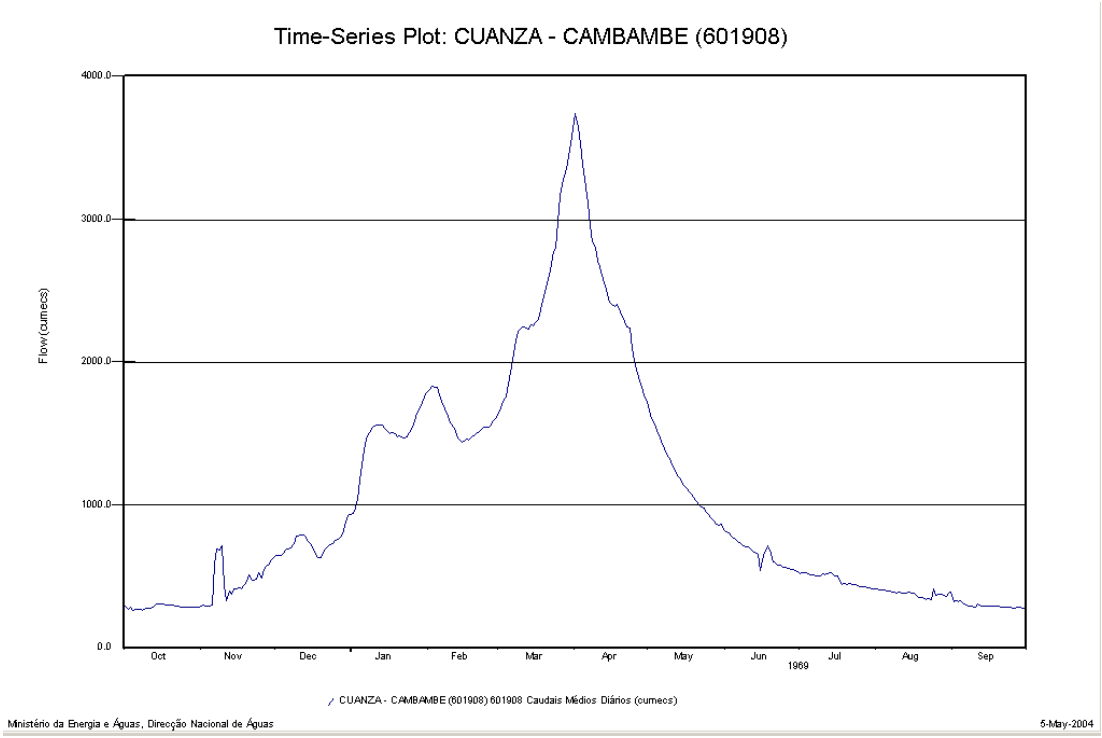
In the quality check 20 stations were "completed" and 26 stations were prepared for further work by the end of 2003. 129 stations were not yet studied! I use "completed" since most of the stations still may have more data, and still may deserve more work.

A change of strategy was made before my second visit at DNA. We found it most valueable to study and prepare as many stations as possible for further work and the final D-MASS analysis. **By this report 125 stations are studied and prepared for further work.** 40 of these are studied only in the database.

By now 24 stations are “completed” (19 good and 5 bad), 7 stations are nearly there (ok?), 48 stations seem very promising and should be there without too much effort (+), 5 stations seem promising but with a doubt (+/?), 33 stations are still full of questionmarks (?) and 8 stations seem very doubious (bad?). After the Versao A job with Cambambe, the total number of stations to handle is 174.

Hydrometry done in Angola before 1975 is solid. The main inputs to the database so far have been water level data and discharge measurements. The strategy has been to convert the water level dataseries into flow series via new rating curves (made by the operator on software from HYDATA). Since we often find results from discharge measurements missing in the archive, I don’t think that this is a complete strategy. Our new rating curves may be “less qualified” than the original curves. The archives often have complete original flow series. They should be introduced to the database as time series of original daily flow.

In some cases, there seems to be no alternatives to introduction of the original flowdata, as shown in an example below. In the archive we find original flowdata from station Cambambe 1952 – 1972. We can’t find valid discharge measurements older than 1969. My feeling is that the original flow data in general are good.



*Flow hydrogram 1968-69, in Rio Cuanza by Cambambe, 121470 km^2. Distribution over the year is typical for Angola. Some years the main rainperiod may start a bit earlier. Dry season May – September. Showers October - January. Rain season February - April. The hydrology-year 1968-69 gave a maximum flow value of 3740 m^3/s – or 31 l/s*km^2, and is – so far - the maximum daily flow value in m^3/s in the Angolan database.*

"Errors":

The HYDATA database and software have some "weaknesses" (or we just haven't learned how to do?) that should be sorted out. Examples on "weaknesses";

- The creation of rating curves with more than two segments (how to handle?)
- The creation of runoff values in l/s*km^2 (should be easy when defined flow/defined area – and you should be able to create these values when you need them. In that way these values wouldn't occupy valueable data storage capacity in the database)
- Print of the table with registered discharge measurements for each station and some other print options that don't function.
- The creation of monthly and yearly values (creation when needed)

The data errors in the database are mainly connected to punching errors. In most cases one will find the correct value in the archive.

Cases of misinterpreting the limnigrams occur now and then. Peaks can be lost due to "mirror-levels".

Some of the data are very rough. I have found examples on flow data from small catchments without decimals, resulting in 0 m^3/s one day and 1 m^3/s the next day.

Connected to changes of 0-level I found examples that this was done on the water level data, but was not done on the water level connected to discharge measurements. This lead to a well fitted rating compared to the discharge measurements, but a totally unfitted rating for the water level data. These errors may be difficult to find, but may have great misleading consequences.

Almost all the ratings in the database needs a check and I am afraid that most of them will need a new rating. To make it proper, this is time consuming work. And still we will miss the opportunity to compare the results of our new rating with the result of the original rating in an efficient way – unless the original flow datas also are present in the database as separate time series.

Limit values in the database needs adjustment at most of the stations. It seems a standard water level range from 0 – 10 m is used. This is just irritating when you pick out plots where the actual range is 0 – 2 m.

3. Further work at DNA

Step one must be to complete the registration of <u>all archive data</u> into the database for the 165 stations (174 – 9 Versao A). Stations that obviously will not give a useful amount of data should be easy to sort out and exclude from further work. A text document and spreadsheets to help overview, priority and exclusion of stations are made (see annex 3 and 4). Recommendations on a systematic approach will be given in this report (see chapter 4).

The quality check was to be carried out in close co-operation with personnel who are working on the NAWASMA project in Angola. The ambition was to train one person from the Angolan hydrology staff. This part of my work failed. There is an obvious shortage of personnel in the staff, which at the time led to priority problems. A possible lack of motivation among parts of the staff is also important to be aware of (lack of wages, low wages). Most of the staff is now trained in English, but my "student" was not. The strategy to train the staff in English is important to continue, in the long term view. To train the staff in data interpretation, how to correct data and construct data for missing periods – and constructing rating curves – is, of course, most important.

DNA provided access to "necessary" maps, historical material and hydrological data for Angola. But I do not feel convinced that all the historical material is at the office in Luanda. I heard that the files (red and black) had been to Portugal before they were returned.

- Can the Portuguese hand over more data?
- Is it possible that elder hydrological data is stored elsewhere?

Systemising the maps over Angola (1:100000, equidistance 50 m) started when I was there. And a "better-map-project" is started.

- Better maps are strongly recommended.

I did not find time to go into questions about related data during my days in Luanda. But for a final completion and a final quality test of the database I would find the following attempts necessary.

- The meteorological data from INAMET should be made available for comparing use in the database. Reliable "met data" can be used to complete and extrapolate the hydrological time series.
- An exchange of data with neighbouring countries is necessary to evaluate the quality of data from stations in borderline rivers. If reliable, "neighbour data" can be used to complete and extrapolate the hydrological time series.
- A historical overview over big flood events would be useful.

The database is not consistent with the physical archives, and not ready for a full quality control. To do proper analysis on the quality – and to get proper information out of the database – you need a certain amount of complete data years.

To correct and complete time series of data takes time. A lot of my first visit in Angola was offered at plain punch operations. To make a quality test before real efforts were done to complete the database, seemed meaningless to me.

Hopefully less work is necessary at the 144 stations that I did not have time to complete, since 125 of them are prepared for further work.

The report annex includes a brief description of each of the stations that have been evaluated so far ("Angola stations") and a document of important notes station by station ("Important notes"). The spreadsheet and notes are created as tools, to maintain a certain overview, when working to complete the database.

The input of runoff values (l/s*km^2) was an idea I got just to be able to get a feeling around either the quality of the catchments area value or the rating. I chose the years 1967/68 and 1972/73 because most of the stations seemed to have data for those years, or one of the years.

In the spreadsheet "Angola stations" the 125 stations studied have got "a quality stamp". The stamps (OK, ok?, +, +/?, ?, bad? and BAD) are signs of hope between the D-MASS tested OK or BAD. Hopefully future work can benefit from these "stamps". **And the stamps are signs of quality by now for the "rapid" work in "Activity C" of NAWASMA.**

In the document "Important notes" I've given as many short comments as possible to describe my findings, station by station. The notes are the result of studying both the archive and the database. In some cases one will find detailed proposals for further work, in other cases just a comment on the situation in the database (usually – "look for more data", "needs new rating" and "adjust time series limits").

Example plots of rating curves and measurements, and example plots from double mass analyses are included. To include all plots seems unnecessary. Some stations have a new rating curve each year, and the volume of plots would overload my report. It is better to have a look at those plots directly from the database (using the list "Angola stations" to find the rating curves evaluated).

4. Conclusions and recommendations

Approaching the first challenges:

The spreadsheet "Angola stations" contains the chosen 165 stations (+ 9 Versao A) and is our guide. It could be an idea to isolate the red and black files of these 165 stations at the office in Luanda (but do not throw the others away).

I have completed the document "Important notes" and the spreadsheet "Angola stations" as far as possible in the available time. In this way you have notes on what to look for before you dive into the archive. And you may get a useful overview if priority questions appear.

The remaining search in the archive and registration into database from the lists following this report should be done at DNA as soon as possible. Sort out the "Versao A"-stations by comparing them against their "mother-stations". Transfer valid data to the "mother-station".

My recommended string of preparatory work - for each station - and the following quality tests:

Introduce data:

- For each station, check database for missing water level values (or flow values at SONEFE-stations). Note the missing periods (see annex "Important notes" were this work is done for a lot of stations). Use the document "Important notes" for further notes.

- Make sure that all water level and discharge measurements are registered. Mark the archive files (red file and black files) when this is completed, and update the "Important notes" and "Angola stations" (still ask – can we find data elsewhere?).

- **Make sure that all original flow data are registered. Name the time series "original daily flow" (Caudais diarios original). Mark the archive files when done, and update "Important notes" and "Angola stations".**

Correct and complete:

- Correct obvious errors in water level - and flow series (often "punching errors"). Use comment options in the database.

- Establish a list of good comparable series (print a copy to the red book). The list will be useful if you later will try to complete by comparing flow or runoff, and for the double mass tests (Comments on possible compare stations are given both in "Important notes" and the spreadsheet "Angola stations").

- Complete water level data or original flow data by comparing with neighbouring stations, as far as possible. Short periods (< 4 days) can often just be interpolated. Longer periods (4 – 30 days) will need construction. In the dry season (May – Oct) even periods > 30 days can sometimes just be interpolated (but do always

check with a proper comparison station). Use the flag and comment options in the database. Update the "Important notes" and "Angola stations".

- Find minimum and maximum water level or original flow value (note in the red book). Adjust limits in the time series editor.

- Check the whole **water level** period for changes of 0-level point (it will often be that the 0-level point is lowered 1.00 m). Notice the date for such 0-level point changes. Such dates will require new rating values, and will be the start of new rating periods. Note the highest water level value (rating h-max). Update the "Important notes" and "Angola stations".

- Check the **discharge measurements**, that their water level is consistent with the water level in the database (you are most likely to find inconsistency at stations with changed 0-level point – and you will find punching errors). Make corrections when you are sure.

- Take a print of the table with discharge measurements, and put it into the red archive file.

- Take a print of the existing rating, and put it into the red archive file.

- **Evaluate water level (stage)/ discharge and flow relationship.** Check rating curves. Adjust if necessary. Make sure that h-max is high enough.

- Make a new flow time series (Caudais Diarios 2). **Convert all water levels in the period with reliable rating** to flow under the new flow time series **(be careful extrapolating periods without discharge measurements)**.

- Compare the new flow time series with the old one – and, if possible, with a neighbouring flow time series or a time series of original flow from the same station. Hopefully the new time series looks better than the old one. If it does, you should delete the old time series – and rename the new one (Caudais Diarios). If it doesn't, you will have to find out why (rating or water level data or settings in the time series description).

Quality test:

- Double mass test data when you think you have finished the work with a group of comparable series.

- Update the "Important notes" and the "Angola stations".

Apart from the registration of data (pure punch operations), the work should be carried out by trained personnel at DNA.

Other recommendations:

A sufficient number of well trained and motivated persons in the hydrology department and hydrometric office is very important.

Questions related to the HYDATA database and software must be answered and necessary action taken. **Sort it out in cooperation with Centre for Ecology & Hydrology.**

Access to historical data from INAMET and other meteorological data must be secured and implemented in the HYDATA database. The most valuable data should be identified before implementation. Secure access to new meteorological data. A promising meeting with with Mr. Gualberto, director of the Angolan Meteorological Institute (INAMET) was held during my last stay.

Access to data from neighbouring countries should be treated the same way, both historical and new data.

A "better map project" is recommended. This may be of national value in many questions besides water resources. To be able to find the correct catchment areas at any point in Angola could be something to aim for, and sufficient altitude precision is of great importance connected to area planning and flood danger.

A nation wide project finding as much data as possible on historical flood events is recommended. A picture from 601804 – Bengo – Cabiri tells something. The database tells nothing about the flood in river Bengo in 1953.

The annual reports (Anuário hidrológico) from DNA are in some cases wrong and incomplete. Use those data with care.

5. Miscellaneous

Hopefully the report and the work enable NAWASMA and the "Activity C" to conclude. I hope that DNA and other Angolan authorities will know the quality of the hydrological data stored in the National database HYDATA better, in order to see what needs to be done to improve the quality. I strongly recommend an effort to take this challenge. This is your water history at the moment.

What I learned from my studies was, that it seems possible to create a high quality nation wide set of hydrological data. Possibly around 100 stations can represent the Angolan hydrology for the years 1965 – 1975.

The annual reports from DNA are in some cases wrong,. the worst example being station 603004 – Queve – Cachoeiras da Binga, where the annual report for 1972-73 gives the annual mean runoff 13,1 l/s*km^2. Correcting the discharge measurements (wrong water level) and establishing a new rating curve gave the annual mean runoff 8,0 l/s*km^2.

And I learned that Angola is a country rich on resources, also water. To exploit the water resources in an optimized cost effective way you need to know more than that. I hope that you have sufficient hydrology data and knowledge to start a meaningful exploitation, and that the Angolan water resources finally will be exploited for the benefit of the Angolan people and environment.

The author at DNA in Luanda, "swimming" in black files.

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Annex list:

1) Terms of reference
2) Symbolic key (spreadsheet)
3) Angola stations (spreadsheet)
4) Important notes
5) Compare plot
6) Ratings, new and old
7) Rating curves, new and old
8) Double mass analyses, plot
9) Angola, list of primary stations (spreadsheet)

DRAFT 23.09.2003

TERMS OF REFERENCE

Consultancy services for a quality check of Angolan Hydrological data.

1 Background

-*Historical background*
A rapid water resources and water use assessment of Angola, is Activity C of the larger "National Water Sector Management" (NAWASMA) project, carried out since 2002 as institutional co-operation between the Angolan National Directorate of Water, DNA (Direcção Nacional de Águas) and the Norwegian Water Resources and Energy Directorate, NVE. The project covers the whole of Angola.

-*Tasks and problems*
The potential of renewable water resources of Angola is not known with sufficient accuracy, mostly due to lack of data. The same is the case for data on total water use, water consumption, and future water demand. Almost all of the 200 hydrometric stations in operation at independence in 1975 have been abandoned during 20 years of civil war. This situation makes proper water development planning practically impossible. This planned work will make a quality check of the Angolan database which consist of historical data from 1950 to 1980. These data will later be used to calculate Angola's renewable water resources.

2 Objectives

2.1 Development goals

The development objective of the NAWASMA project is improved water sector management in Angola through a strengthened institutional capacity of DNA.

Proper water management requires solid knowledge. An operational database with quality hydrological data is essential in order to evaluate Angola's renewable water resources.

3 Scope of work

3.1 General

The lack of relevant data is a major problem (cf. 1 above). Hydrological data from the 1950-1975 period and sporadic data since 1975 are stored in a HYDATA database at DNA. The quality of the digitisation of data is uncertain, and a quality check of the data is necessary before these data can be use for water resources assessment.

In order to check the quality of this data, it is necessary to work trough a list of the most important hydrological stations in the different basins of Angola and to perform the following tests on each station:

- Check the consistency between water level time series and discharge time series for each of the station, if not consistent, convert all existing water level to discharge.
- Check of catchments area
- Evaluation of stage / discharge relationship (rating curve)
- Double mass test of the data
- Validation plot test of the data

3.2 Preparatory work

It is required to have good knowledge in the use of HYDATA hydrological software and knowledge of Angola's river basins and international river systems.

4 Mode of work

The project shall be carried out in close co-operation with personnel who are working on the NAWASMA project in Angola. The client, DNA, shall provide access to necessary maps, historical material and hydrological data for Angola. The work shall be carried out in DNA ´s office in Luanda and a Pc with access to the National database will be provided.

5 Time schedule

The work is estimated to take one month, and should take place in October / November 2003.

6 Reporting

The final report should enable DNA and other Angolan authorities to know more on the quality of the hydrological data stored in the National database HYDATA. The report should include a brief description of each of the stations that have been evaluated, including plot of the rating curve and measurements, double mass analyses and validation plot from HYDATA.

The final report should be submitted in 5 copies as well as in electronic form.

7 Budget

Fee NVE , 10 Days in Norway preparatory work	47 250
Fee NVE , 30 days in Luanda	141 750
Fee NVE , 10 Days in Norway, Report	47 250
Travel to Angola, 30 days stay	128 000
Visas, vaccination etc	5 000
Sum (Norwegian Kroner, NOK)	NOK 369 250

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National Director of Water, DNA

Key to fonts, symbols and colours used in the spreadsheet

The spreadsheets and the "important notes" should be used together

Only stations marked BAD or OK in column D-MASS are fully evaluated. ok? and + should be given priority for further work

Total number of stations is 174
19 (primary stations)
+ 137 (secondary stations)
+ 11 (Cabinda and Versao A)
+ 7 stations originally excluded by Mr P.E. Mendes

Number	Latitude	Longitude	Elevation	Area	Q/sq km	Level	Q	Q-measured	D-MASS	STATION NAME	Key to the symbols:
	*:min:sec	*:min:sec	(metres)	(sq km)	l/s x km2	period	period	period	status		
					67-68/72-73	date-date	date-date	date-date	OK/+/?/BAD		OK/+/?/BAD present status quality marks . + means do further work **now**
400301											Station in the Cabinda province
601304											Red station numbers were left out by P.E. Mendes, and that they are not studied
601301											**Bold black font means primary station**
	9:29: 0 S	20:21: 0 E	1070	6250							Geo-data checked and found to be equal in archive, database and the annual reports
	11:13:0 S	20:12:0 E	1260	5400							Geo-data checked, but I still find reason to doubt the area.
				1							Obvious errors
601702	8:10: 0 S	15:17: 0 E	1153	107						DANDE - CANHONGO - PONTE (601702)	All white row means not studied at all
									BAD?	ZAIRE - CUILO - PONTE (ALFANDEGA) (430504)NB Important	Hints regarding the station are some times given close to the station name in blue (this example: Important station, but probably BAD)
										CUANZA - LUINGA - BACUANGA (601904)**compare 601916**	**Useful stations for comparison are often mentioned close to the station name**
43050202	9:29: 0 S	20:21: 0 E	1070	5410						ZAIRE - CHICAPA - SAURIMO (VERSAO A) (43050202)	Versao A, should be compared to its station - and valid data should be kept under the original station number. After that the versao A should be deleted
Examples:											
601101	**7:21: 0 S**	**14:54: 0 E**	**670 (96?)**	**484**	**11,2/?**	**oct67-sep71**	**oct67-sep71**	**dec66-okt70**	**+**	**M'BRIDGE - LOA - FAZENDA LOA (601101)compare ?**	**& data 80-82, reconvert Q - OK,**
The station above is a primary station, geo-data are checked but different elevation found in different sources. No data to give a runoff value for 72-73 found. Measurements from dec66 could indicate that we possibly can find level data earlier than oct67. + means that we are almost ready to complete the work at this station. The compare note means that I've not found a proper station for compare use. The comments shows that we have further data 80-82 (but 1967-1971 will probably stay as the qualified data period). Level datas are reconverted to Q.											
601301	**7:45: 0 S**	**15: 5: 0 E**	**900**	**182**	**?/3,8**	**oct67-sep73**	**oct67-sep73**	**mar68-aug74**	**+**	**LOGE - LUQUIXE - BARRAGEM (601301)**	**Bold font in number and name means primary station**. Red colour means that here is more work to do or more data to look for. + means "give it a high priority" (probably because the station is picked out as a primary station - or it could be a small job !)

Ministério da Energia e Águas, Direcção Nacional de Águas

List of best quality stations and their details, evaluated October - November 2003 and March - April 2004
Only stations marked BAD or OK in column D-MASS are fully evaluated. ok? and + should be given priority for further work

Total number of stations is 174.
156 stations in Angolan main land
+ 11 stations (in Cabinda and Versao A-stations)
+ 7 stations originally excluded by Mr P.E. Mendes

Number	Latitude	Longitude	Elevation	Area	Q/sq km	Level	Q	Q-measured	D-MASS	Name	Comments in general
	*:min:sec	*:min:sec	(metres)	(sq km)	l/s x km^2	period	period	period	status		(what is done or should be done ?)
					67-68/72-73	date-date	date-date	date-date	OK/+/?/BAD		OK/+/?/BAD as quality marks by now. + means do further work **now**
400301	5:24: 0 S	12:13: 0 E	0	1	?/?	none	none	none	BAD?	LULONDO - BUCUMAZE (400301)	No time series established, look for data
400401	5:33: 0 S	12:15: 0 E	0	354	?/?	sep83-sep84	sep83-sep84	feb84-jul85	?	N'HAMA - LUCOLA - CABINDA (400401)	Need more data, adjust limits, 7 measurements
430501	11: 1: 0 S	20:12: 0 E	1250	2100	9,2/7,7	oct65-sep74	oct65-sep74	oct65-oct73	OK	ZAIRE - CHIUMBE - DALA (430501)	**Good red file. Compare 430503/430502 is OK.**
430502	**9:29: 0 S**	**20:21: 0 E**	**1070**	**6250**	**11,1/10,3**	**oct65-sep74**	**oct65-sep74**	**oct65-sep73**	**OK**	**ZAIRE - CHICAPA - SAURIMO (430502)**	**also data 1977-84. Area changed, see red book**
430503	11:13: 0 S	20:12: 0 E	1260	5400	12,8/10,0	oct65-sep74	oct65-sep74	sep65-des68	OK	ZAIRE - CASSAI - PONTE (430503)	complete. New rating curve
430504	7:33: 0 S	15:49: 0 E	1120	1400	?/9,6	feb67-jun75	feb67-jun75	feb67-aug72	BAD?	ZAIRE - CUILO - PONTE (ALFANDEGA) (430504)NB Important	wrong Q-rateing, levelmark changed ? Too much dataloss
430506	9:40: 0 S	20:35: 0 E	960	1	?/?	oct72-sep84	none	sep76-mar82	?	ZAIRE - LUACHIMO - SAMUPAFO (430506)	Level gaps 75-78, 36 measurements, make rating
430511	9:43: 0 S	20:56: 0 E	950	1	?/?	feb73-apr84	none	oct76-jul84	?	ZAIRE - MUANZANZA (430511)	new coordinates 15.10.03,see important notes (0-level change ++)
430513	10: 2: 0 S	19:31: 0 E	1150	1	?/?	dec73-jun82	none	apr80-may82	?	ZAIRE - CUILO - ALTO CUILO (430513)	Level gaps 75-77, 20 measurements
601101	**7:21: 0 S**	**14:54: 0 E**	**670 (96?)**	**484**	**11,2/?**	**oct67-sep71**	**oct67-sep71**	**dec66-okt70**	**+**	**M'BRIDGE - LOA - FAZENDA LOA (601101)compare ?**	**& data 80-82, reconvert Q - OK,**
601102	7:22: 0 S	14: 3: 0 E	0	509	?/?	dec66-feb68	none	none	?	M'BRIDGE - LUCUNGA - F. LUCUNGA (601102)	One year of level data, more in archive?
601103	6:13: 0 S	14:41: 0 E	0	1	?/?	apr79-dec82	none	none	?	M'BRIDGE - SERRA DA CANDA (601103)	Level gaps possible to fill? Any measurements?
601105	7:14: 0 S	14:52: 0 E	0	1	?/?	dec79-oct83	none	none	?	M'BRIDGE - LUCUNGA - STA LEOCADIA (601105)	Level gaps possible to fill? Any measurements?
601301	**7:45: 0 S**	**15: 5: 0 E**	**900**	**182**	**?/3,8**	**oct65-sep73**	**oct67-sep73**	**mar68-aug74**	**+**	**LOGE - LUQUIXE - BARRAGEM (601301) Has more data**	**A-rating ? Need data 67, 68. 18 measurements 3 - 12 m3/s**
601302	7:47: 0 S	13: 6: 0 E	11	1	?/?	dec68-apr74	none	none	?	LOGE - FAZENDA LOGE (601302)	some levels 81-82. Check files for more data. Small level gaps (?)
601304	0: 0: 0 N	0: 0: 0 E	0	1	?/?	oct80-dec83	none	none	?	LOGE - FREITAS MORNA (601304)	Check files for more data
601701	**8:36:15 S**	**13:33:26 E**	**36**	**10660**	**?/6,0**	**aug68-dec7**	**aug68-dec7**	**oct68-may75**	**OK**	**DANDE - PORTO QUIPIRI (601701)**	**Coordinates changed (from GPS)**
601702	8:10: 0 S	15:17: 0 E	1153	107	?/?	jan66-oct71	oct67-sep71	dec63-sep70	?	DANDE - CANHONGO - PONTE (601702)	Need better rating, see important notes. Adjust limits
601703	8:15: 0 S	15:15: 0 E	1050	25 (250?)	"80"/?	dec65-sep71	oct68-sep70	jun66-dec82	bad?	DANDE - MAMBULO - PONTE (601703)	Unstable level, also level data 81-83, needs better rating. Area?
601704	8:17: 0 S	15:19: 0 E	1000	183	"10"/?	dec65-sep72	oct67-sep72	mar68-sep70	+	DANDE - MAMBULO II - QUEDAS (601704)	Small level gaps. Wrong stage in mesurements? See important notes
601706	**8:24:45 S**	**14:36:20 E**	**450**	**5191**	**?/12,0**	**oct70-jun75**	**oct70-jun75**	**sep72-aug74**	**OK**	**DANDE - PONTE DE QUIBAXE (601706)**	**Area, elevation and coordinates from red book**
601804	**8:55: 0 S**	**13:40: 0 E**	**10**	**8053**	**5,1/6,0**	**may59-sep7**	**may59-sep7**	**feb62-oct80**	**OK**	**BENGO - CABIRI (601804)**	**GPS. Level 62/63,64/65,66/67 now OK. Regulated from 74**
601806	8:58: 0 S	13:43: 0 E	14	6364	6,7/?	oct54-jul71	oct54-jul71	oct54-jul71	OK	BENGO - LALAMA (601806)completed by Olav	Good info in red book 21.
601810	8:53: 0 S	14:31: 0 E	220	5420	?/?	nov70-nov78	none	oct70-oct78	BAD?	BENGO - ZENZA - FAZENDA BOM JARDIN (601810)	Too much dataloss, waterlevel? **Try 601805 ?**
601901	9: 3: 0 S	16: 4: 0 E	990	2990	4,1/4,5	jan64-sep65	oct67-sep74	none	?	CUANZA - LUANDO - AFLUENTE DO COLE (601901)	more level, Q-data or measurements ? See SONEFE-books
601902	9:10:30 S	13:33:30 E	8	155462	?/?	apr56-may75	none	none	OK	CUANZA - BOM JESUS (601902) level completed	Area= 155 462 in red book. For compare use**601909**
601903	10:38: 0 S	16:36: 0 E	1043	12388	15,1/8,0	may64-sep6	oct67-sep74	none	+	CUANZA - CUTATO - BANGA (601903)	more level, Q-data or measurements ? See SONEFE-books
601904	9:58: 0 S	15:27: 0 E	882	1248	1,5/2,9	dec62-sep65	oct67-sep74	none	+	CUANZA - LUINGA - BACUANGA (601904)**compare 601916**	more level, Q-data or measurements ? See SONEFE-books
601905	11:59: 0 S	17:40: 0 E	1300	24790	9,4/?	apr59-sep69	oct67-jun72	none	+	CUANZA - POVOACAO DO CUANZA (601905)	more Q-data or measurements ? See SONEFE-books
601906	10:24: 0 S	16:26: 0 E	1050	62790	10,6/5,6	oct64-sep66	jun64-oct74	none	+	CUANZA - CAUISSO (601906)	more level data in archive, but no measurements. More Q-data ?
601907	9:48: 0 S	15:28: 0 E	900	114042	?/?	oct70-jun75	none	JUN87-AUG8	+	CUANZA - CAPANDA (601907)	more level data in archive 66-69,more measurements OR Q-DATA ?
601908	9:45: 0 S	14:29: 0 E	187	121470	9,2/?	oct59-sep72	oct67-sep72	feb63-mar04	+	CUANZA - CAMBAMBE (601908)**compare 601936/601944**	level missed 64-69, real measurements after 1969, some Q-data 87-89
601909	9:17:00	13:45:00	12	154272	?/?	oct56-sep71	none	none	OK	CUANZA - CABALA (601909)	LEFT OUT BY PAULO EMILIO MENDES
601913	8:26: 0 S	15:51: 0 E	1133	4140	11,7/?	jan64-sep64	oct67-sep74	may78-mar79	?	CUANZA - LUCALA - CATECO CANGOLA (601913)	more level, Q-data or measurements ? See SONEFE-books
601915	11:50: 0 S	17: 4: 0 E	1400	45	?/?	feb67-mar71	feb67-mar71	none	+/?	CUANZA - LUVULO - CAPOLO (601915)	more level, Q-data or measurements ? See SONEFE-books
601916	11:29: 0 S	16:54: 0 E	1450	996	22,1/12,6	oct65-sep66	oct65-jun75	none	+	CUANZA - CUNHINGA - CAPEIO (601916)**see 601956**	more level, Q-data or measurements ? See SONEFE-books
601917	11:27: 0 S	16:21: 0 E	1400	7033	16,7/10,4	aug59-may6	oct67-sep74	none	+	CUANZA - CUTATO - CUTATO ANDULO (601917)**see 601903**	more level, Q-data or measurements ? See SONEFE-books
601918	9:59: 0 S	15:10: 0 E	1078	1006	?/1,7	dec62-sep66	oct67-sep74	none	+	CUANZA - BUINZA - CALOMBO (601918)	more level, Q-data or measurements ? See SONEFE-books
601920	12:39: 0 S	16:54: 0 E	1580	941	?/?	oct66-nov69	oct67-sep69	feb68-sep69	+	CUANZA - CUQUEMA - CHAVAIA (601920)need new rating	more level, Q-data or measurements ? See SONEFE-books
601921	12: 4: 0 S	17:36: 0 E	1300	8202	12,5/7,7	may64-sep7	oct64-mar75	none	bad?	CUANZA - CUQUEMA - CHIMBUNDE (601921)	more level, Q-data or measurements ? See SONEFE-books
601922	11:47: 0 S	17:31: 0 E	1300	2928	?/8,2	may64-sep6	oct68-apr75	none	bad?	CUANZA - CUNJE - CHIMBUNDE (601922)	more level, Q-data or measurements ? See SONEFE-books
601923	9:41: 0 S	14:25: 0 E	29	121707	?/?	oct54-sep82	none	none	+	CUANZA - DONDO (601923)	A lot of data in archive, could confirm and complete CAMBAMBE?
601924	10:30: 0 S	17:45: 0 E	1080	59	?/?	oct63-sep69	none	none	bad?	CUANZA - L.CATETE - DOMBO (601924)AREA?	Valueable compare station for 601958 RIMBA LUCUEMBO ?
601925	9:32: 0 S	14:40: 0 E	350	1280	?/?	oct64-aug70	oct64-sep74	none	bad?	CUANZA - MUCOSO - DANGE IA MENHA (601925)	260 m asl in yearbook, area ? Q-?
601926	10:49: 0 S	16:44: 0 E	1100	4082	?/8,4	may64-sep6	oct68-sep74	none	+	CUANZA - CUNHINGA - FOZ (601926)**compare 601916**	more level, Q-data or measurements ? See SONEFE-books
601927	9:47: 0 S	14:37: 0 E	210	1286	1,8/?	dec63-sep70	oct67-sep72	none	?	CUANZA - LUA - FOZ (601927)**compare 601918**	more level, Q-data or measurements ? See SONEFE-books
601928	11:57: 0 S	17:27: 0 E	1387	1286	?/?	oct64-aug72	oct64-aug72	oct67-jul71	+	CUANZA - CUNJE - CAMACUPA (601928)**compare 601922**	more measurements in red file 1964-1968, two Q-series.
601929	10:38: 0 S	15:53: 0 E	1590	2691	8,4/8,8	aug59-sep66	oct67-sep74	none	+	CUANZA - GANGO - GANGO (601929)**compare 601962**	more level, Q-data or measurements ? See SONEFE-books
601930	9:31: 0 S	14:23: 0 E	25	25290	4,5/4,9	may54-sep6	oct67-sep74	none	+	CUANZA - LUCALA - Km 34 (601930)**compare 601931**	lots of info in red file. Possible to introduce a lot
601931	9:16: 0 S	15:15: 0 E	600	19450	5,1/6,1	jun54-sep66	oct67-sep74	none	+	CUANZA - LUCALA - LUCALA (601931)**compare 601930**	lots of info in red file. Possible to introduce a lot
601935	10:19: 0 S	16:35: 0 E	1050	29290	7,9/5,1	dec62-sep66	oct67-sep75	none	ok?	CUANZA - LUANDO - LUCUNGA (601935)**see 601901/601906**	more level, Q-data or measurements ? See SONEFE-books
601936	9:43: 0 S	15:43: 0 E	940	104810	9,7/5,4	dec62-sep64	dec62-apr75	none	OK	CUANZA - MUTULA (601936)**see 601908/601944**	Q-seems good along compare stations, but even more data ?
601938	9:31: 0 S	13:58: 0 E	12	152217	?/?	oct57-sep82	none	none	?	CUANZA - MUXIMA (601938)	Almost complete levels, look for data. Q-data?
601942	11:14: 0 S	17:25: 0 E	1200	38270	9,2/4,9	jan63-sep65	jan63-sep75	none	ok?	CUANZA - N'HAREA (601942)**see 601905/601906**	Q-seems good along compare stations, but even more data ?
601943	12: 7: 0 S	17:17: 0 E	1440	942	23,8/9,9	oct65-nov74	oct65-nov74	jul64-jul75	ok?	CUANZA - CUNJE - CATABOLA (601943)**see 601922/601928**	A lot of work done. The data should be OK now.
601944	9:53: 0 S	16:17: 0 E	1050	96740	10,1/5,4	oct56-sep68	oct67-sep73	"jun65-jun65"	ok?	CUANZA - CANGANDALA (601944)**see 601908/601936**	Q-seems good along compare stations, but even more data ?
601945	11:59: 0 S	17:43: 0 E	1260	5240	11,3/?	feb63-sep69	oct63-sep74	none	+	CUANZA - CUIVA - P.FRITAS MORNA (601945)	more level, Q-data or measurements ? See SONEFE-books
601946	9:39: 0 S	16:24: 0 E	1030	3200	5,7/8,2	nov77-sep82	oct67-sep74	**dec77-oct83**	+	CUANZA - CUIJE - PONTE DO CUIJE (601946)	Dubious, but ... ?
601949	9: 6: 0 S	16: 2: 0 E	970	7010	2,9/3,6	jun59-sep64	oct67-sep74	none	+/?	CUANZA - COLE - POUSADA DO DUQUE (601949)**see 601950**	some years are dubious

Number	Latitude	Longitude	Elevation	Area	Q/sq km	Level	Q	Q-measured	D-MASS	Name	Comments in general
	*:min:sec	*:min:sec	(metres)	(sq km)	l/s x km^2	period	period	period	status		(what is done or should be done ?)
					67-68/72-73	date-date	date-date	date-date	OK/+/?/BAD		OK/+/?/BAD as quality marks by now. + means do further work **now**
601950	8:56: 0 S	16: 1: 0 E	1106	6870	8,9/10,5	oct61-sep64	oct67-sep74	none	+	CUANZA - LUCALA - PONTE RAUL LIMA (601950)	no rating, no measurements - lots of info in red book 76
601951	9: 8: 0 S	15:58: 0 E	950	15000	6,2/7,1	none	oct67-sep75	none	+	CUANZA - LUCALA - P.VIEIRA MACHADO (601951)	more level, Q-data or measurements ? See Q-data in red file
601953	9:26: 0 S	14:45: 0 E	240	23270	4,6/5,3	jun59-sep64	oct67-sep74	none	ok?	CUANZA - LUCALA - PONTE PINHEIRO CHAGAS (601953)	more level, Q-data or measurements ? See SONEFE-books
601954	12:31: 0 S	17:26: 0 E	1320	5943	?/?	jan63-sep66	jan63-jun75	none	bad?	CUANZA - COQUEMA - PONTE DA CAMBANDUA (601954)	a lot of missing Q-data
601955	**9:48: 0 S**	**15:13: 0 E**	**780**	**116400**	**9,4/5,5**	**apr64-sep64**	**apr64-sep75**	**none**	**OK**	**CUANZA - QUISSAQUINA (601955)**	**SONEFE. Compare 601936. Red file # 81.**
601956	11:24: 0 S	16:53: 0 E	1300	1007	?/10,8	aug59-sep68	oct68-sep74	none	ok?	CUANZA - CUNE - QUEDAS DO LAU LAU (601956)**see 601916**	0-level changes ? Q-data seems OK, area ?
601957	11:54: 0 S	16:35: 0 E	1450	2909	16,9/9,1	feb63-sep66	oct67-sep74	none ?	+	CUANZA - CUTATO - QUEDAS (601957)**see 601917**	was missing sept73 & sept 74. More data (SONEFE)?
601958	10:32: 0 S	17:30: 0 E	1070	5150	7,9/5,2	nov60-sep66	oct67-sep73	none	+	CUANZA - JOMBO - RIMBA LUQUEMBO (601958)	more Q-data in red file. And SONEFE-books ?
601962	9:59: 0 S	15:42: 0 E	1030	5557	6,1/6,1	dec62-sep66	oct67-sep74	none	+/?	CUANZA - GANGO - VILA VERDE (601962)**see 601929**	more level, Q-data or measurements ? See SONEFE-books
602501	11: 3: 0 S	15: 5: 0 E	1200	1264	6,8/9,7	oct64-sep81	oct67-sep73	oct67-apr81	?	LONGA - NHIA - BUIA (602501)**new rating F made**, needs more	should be possible to create more Q-data if measurements
602502	10:48: 0 S	14:46: 0 E	1090	3676	5,8/7,3	oct64-sep81	oct67-sep73	oct69-sep73	?	LONGA - NHIA - CASSONGO (602502)	needs full re-rating, look for more data
602503	10:35: 0 S	15:20: 0 E	1210	2610	?/6,5	oct69-sep74	oct69-sep74	nov69-sep73	?	LONGA - CARIANGO (602503)	needs re-rating, especially B-rating, look for more data
602505	10:51: 0 S	15: 4: 0 E	1210	1279	4,2/?	oct64-sep71	oct67-jun70	none	??	LONGA - CATOFE - CATOFE (602505)	Q-seems too low.
602506	**10:16: 0 S**	**14:48: 0 E**	**1050**	**6332**	**4,8/6,6**	**nov64-sep8**	**oct67-sep73**	**feb68-mar81**	**?**	**LONGA - QUISSUCA (602506) Not completed**	**Check red and black book, needs new rating**
602507	10: 8: 0 S	14:12: 0 E	30	8659	?/6,2	aug70-may7	oct72-sep73	aug72-feb80	?	LONGA - QUILONGA (602507)	more data ? Needs new rating
602508	10:50: 0 S	15: 4: 0 E	1210	3676	?/1,8	jun70-apr75	oct70-sep74	jun70-mar75	?	LONGA - CATOFE - FABRICA (602508)	Wrong area ? No info in red book, needs new rating > 60 measurement
602510	10:40:30 N	15:12:29 E	1900 ?	1	?/?	oct73-apr75	none	sep73-mar75	BAD?	LONGA - POMBUIGE - TARI (602510)Bad if not a lot more data	**No red book/no black book ?? 17 measurements**
603001	12:12: 0 S	15:36: 0 E	1410	2887	19,4/16,8	oct64-sep73	oct67-sep73	mar68-sep74	+	QUEVE - ALTO HAMA (603001)left out by Paulo Emilio ?	new coordinates 14.10.2003area= 4325 or 4412
603003	11:51: 0 S	15:22: 0 E	1340	9887	11,8/9,1	oct64-sep73	oct67-sep73	oct67sep73	+	QUEVE - CAIOVOLE (603003)	Check red and black book, needs new rating
603004	**10:59: 0 S**	**14: 5: 0 E**	**45**	**20352**	**9,0/8,0**	**oct64-jun75**	**oct64-jun75**	**dec67-aug76**	**OK**	**QUEVE - CACHOEIRAS DA BINGA (603004)**	**level completed, new rating (+1 m) OK. NB-Yearbook**
603006	11:57: 0 S	15:21: 0 E	1380	789	?/11,3	oct64-jul75	oct68-sep73	apr68-jul75	?	QUEVE - CUCHEN - CATATO (603006) level not completed	needs new rating, and reconvert. More measurements in archive ?
603007	12:22: 0 S	15:39: 0 E	1430	1153	?/10,7	mar65-jul75	oct67-jul75	oct67-jul75	?	QUEVE - CUITO - CHITATAMERA (603007)	suspect data, check rating. Two Q-series
603008	11:45: 0 S	15: 1: 0 E	1370	727	?/?	mar65-jul75	oct67-jul75	oct67-jul75	+	QUEVE - COVELE - GONGO (603008)fill in wl 69,73,75 (short per)	Chech for more measurements, has 85. Needs better rating.
603009	11: 8: 0 S	14:48: 0 E	1240	18304	9,5/7,7	oct64-jun75	oct64-jun75	oct66-jul75	OK	QUEVE - GINGA (603009)	level completed/corrected, new rating OK.
603010	10:57: 0 S	14:11: 0 E	215	397	5,2/3,4	jan65-sep83	oct67-may75	dec67-jul75	+	QUEVE - CHILO - HINCHINGO (603010)	Level gaps 75-77, needs rerating, 92 measurements (more in archive?)
603013	12: 2: 0 S	15:23: 0 E	1400	1	?/?	oct70-jul75	none	oct70-jul75	+	QUEVE - CUVOMBUA - LUBIRI (603013)	Almost complete levels, needs re-rating. 74 measurements
603016	11:36: 0 S	15:50: 0 E	1430	372	?/?	mar65-sep70	oct68-sep70	nov67-may71	+	QUEVE - CUVIRA - TRANGALA (603016)	Almost complete levels, needs re-rating. 29 measurements
603017	11:10: 0 S	14:53: 0 E	1259	763	?/?	may66-jun75	none	none	?	QUEVE - CUSSOI - TACANHO (603017)	Almost complete levels. Find measurements or Q-data.
603018	12:17: 0 S	15:47: 0 E	1390	1388	?/?	mar65-sep71	oct68-sep70	apr68-sep75	+/?	QUEVE - CULELE - VINGANGA (603018)	Levels need correction. Needs new rating. 41 measurements
603019	11:31: 0 S	14:53: 0 E	1249	751	?/?	oct71-jul75	none	oct70-may72	?	QUEVE - CANINDA - VERGANISTA (603019)	Dubious levels. Check measurements stage 1,88 m. Needs new rating
603020	11:47: 0 S	15:35: 0 E	1350	420	?/?	oct69-jul75	none	oct67-jul75	+	QUEVE - CUNHANGAMA - CAPOCO (603020)	Levels may be hopeful, but needs correction. Need new rating
603021	15:35: 0 S	12:11: 0 E	1265	12532	?/?	feb65-sep68	none	none	bad?	QUEVE - JANGADA NOVA LISBOA (603021)	new coordinates 14.10.2003.Look for more data, BAD if no more
603023	12:36: 0 S	15:40: 0 E	1500	251	?/?	nov71-jul75	none	nov70-jun79	?	QUEVE - CALONGUE - SAMAINA (603023)	suspect level data, awful rating, but 75 measurements
603101	11:17: 0 S	14:21: 0 E	950	1176	9,4/12,8	may65-sep8	reconvert	dec67-sep73	+	N'GUNZA - GANJA (603101) NB looks good. Area ?	one ratingperiod ? Fill in level datas 75 - 81.
603201	11:44: 0 S	14:27: 0 E	750	3473	11,0/11,8	nov64-jul75	oct67-jul75	dec67-apr75	+	QUICOMBO - CATANDA (603201)Area ?	Level gap 66-67. Need re-rating. 103 measurements
603202	11:19: 0 S	13:51: 0 E	6	5581	?/6,7	lost ?	oct67-jul75	oct67-jul80	+	QUICOMBO - QUICOMBO (603202)Area ?	Lower Q than upstreams, compare ?? 111 measurements
603403	**11:49: 0 S**	**13:57: 0 E**	**190**	**878**	**?/?**	**jun66-**	**none**	**none**	**BAD**	**EVALE - LOETO DESCARREGADOR (603403)**	**try 603402 ? Better datas in DOS ? Only level ?**
603501	12:24: 0 S	14:43: 0 E	1200	871	17,7/?	nov64-nov70	oct67-sep70	feb68-aug70	+	BALOMBO - CAPECO (603501)	Levels need work, and new rating needed. 23 measurements
603502	**11:59: 0 S**	**14: 0: 0 E**	**240**	**3842**	**10,5/?**	**oct66-jul75**	**oct67-jul75**	**dec67-jun81**	**+**	**BALOMBO - CANJALA (603502)**	**More data in archive ? 112 measurements 67-81.**
603504	12:23: 0 S	14:43: 0 E	0	1	?/?	nov70-aug75	none	oct70-aug76	+	BALOMBO - CAPECO MOINHOS (603504)	Small level gaps. Needs rating (is the last measurement really in 1976?
603701	**12:15: 0 S**	**13:45: 0 E**	**45**	**2119**	**4,0/3,0**	**nov64-aug8**	**oct67-aug82**	**feb68-sep73**	**+**	**CUBAL DA HANHA - HANHA (603701)**	**More data in archive ? 63 measurements 68-73. 0 change**
603801	12:29: 0 S	13:45: 0 E	195	15829	9,3/?	oct62-jul74	oct62-jul74	may63-oct64	+	CATUMBELA - BIOPIO (603801)	Small level gaps. Check rating. 37 measurements. Find more!!
603802	12:46: 0 S	13:56: 0 E	540	14982	9,8/?	feb62-oct71	oct67-sep71	none	?	CATUMBELA - CAIAVE (603802)	Has complete wl. Needs rerating every year? Find data
603803	12:49: 0 S	14:41: 0 E	1218	3157	12,9/?	jan62-sep71	oct67-sep71	none	?	CATUMBELA - CUIVA - CUIVA (603803)	Wl complete apart from gap 67-68. 0-level change? More data ?
603804	13: 2: 0 S	14:13: 0 E	876	3653	10,8/?	nov62-sep71	nov62-sep71	none	+	CATUMBELA - CUBAL DA HANHA - CUBAL (603804)	0-level change 67-68? Wl and Q complete, but only rating from 67?!!
603805	12:47: 0 S	13:57: 0 E	545	4860	7,9/?	feb62-sep71	oct61-sep71	none	?	CATUMBELA - CUBAL DA HANHA -CAIAVE (603805)	Wl complete. Big Q gap 62-67! More data?
603806	13:22: 0 S	14:53: 0 E	1500	2128	9,9/?	jan62-oct71	oct67-sep71	none	?	CATUMBELA - CHICUMA (603806)	Wl complete. Q-gap 70. One rating, check rating. More data ?
603807	12:58: 0 S	14:53: 0 E	1254	3424	9,7/?	jan62-sep71	oct67-sep71	none	?	CATUMBELA - LUPOMBA (603807)	Wl almost complete. Obvious errors. Correct and reconvert. More?
603808	**12:44: 0 S**	**14:27: 0 E**	**1000**	**8296**	**11,3/?**	**feb62-sep70**	**nov61-sep7**	**apr63-sep67**	**+**	**CATUMBELA - LOMAUM (603808)**	**Area 11560 ? Quipuco introduced measurements 23.03.04**
603809	12:28:50 S	13:46:10 E	206	15800	?/?	none	none	none	(+)	CATUMBELA - BIOPIO - II (HYCOS) (603809)	?-AREA. (+) since it is reestablished, see 603801
603901	12:46: 0 S	13:37: 0 E	0	1						CAVACO - GUVRIRE (603901)	
603902	12:54: 0 S	13:45: 0 E	0	1						CAVACO - UTENGUE (603902)	
604603	**12:59: 0 S**	**13: 9: 0 E**	**7**	**1**	**?/?**	**oct52-jul83**	**none**	**jul73-nov76**	**+/?**	**COPOROLO - DOMBE GRANDE (604603)**	**no area, elevation or coordinates in red/black**
606701	**15:35:23 S**	**12:49:36 E**	**360**	**1**	**?/?**	**feb70-apr70**	**none**	**none**	**bad?**	**BERO - TAMPA (DESCARREGADOR) (606701)**	**new elevation when new maps. Need water level data**
607201	16:22: 0 S	13:21: 0 E	970	4170						COROCA - MAXAXA (607201)	
607202	16:17: 0 S	12:34: 0 E	0	1						COROCA - PEDIVA (607202)	
607303	16:14: 0 S	14:10: 0 E	1180	8063						CUNENE - CACULUVAR - COVA DO LEAO (607303)	
607304	15:22: 0 S	15:51: 0 E	1200	4510						CUNENE - COLUI - CATEMBULO (607304)	
607306	14:49: 0 S	15: 2: 0 E	1185	6994						CUNENE - CALONGA - CASTANHEIRA DA PERA I (607306)	
607307	13:23: 0 S	15:32: 0 E	1530	1562						CUNENE - CALAI - CALAI (607307)	
607308	17:17: 0 S	14:31: 0 E	1050	86188	1.3					CUNENE - IACAVALA (607308)	

Number	Latitude	Longitude	Elevation	Area	Q/sq km	Level	Q	Q-measured	D-MASS	Name	Comments in general
	*:min:sec	*:min:sec	(metres)	(sq km)	l/s x km^2	period	period	period	status		(what is done or should be done ?)
					67-68/72-73	date-date	date-date	date-date	OK/+/?/BAD		OK/+/?/BAD as quality marks by now. + means do further work **now**
607309	14:26: 0 S	15: 4: 0 E	1240	2769						CUNENE - CATAPI - CHEREQUERA (607309)	
607310	13:15: 0 S	15:35: 0 E	1590	837	16,7/9,7	oct66-jul75	oct67-sep73	oct68-sep73	+	CUNENE - CALAI - CHISSOLA (607310)	Good information in red book 163. More measurements ?
607312	13:27: 0 S	15:53: 0 E	1550	4811						CUNENE - GOVE I (607312)	
607314	13:46: 0 S	15:30: 0 E	1490	8637	14,4/7,8	dec63-jul75	oct67-jul75	oct67-jul65	+	CUNENE - JAMBA IA HOMA (607314)	Yearbook 72/73 says Area= 1490, which is wrong
607315	14:13: 0 S	15:24: 0 E	1290	13817	13,7/7,0	aug63-jul75	oct67-jul75	jan68-sep73	+	CUNENE - JAMBA IA MINA (607315)	Wl almost complete. Q also. Bad B-rating
607316	14:38: 0 S	15: 5: 0 E	1220	18849	5.8					CUNENE - LUCEQUE (607316)	
607317	13:47: 0 S	15:25: 0 E	1480	1480	7.8					CUNENE - CUANDO - LUCUNDE (607317)	
607318	14:38: 0 S	15: 5: 0 E	1230	5715	?/?	mar71-jul75	none	none	?	CUNENE - CATAPI - LUCEQUE (607318)	Wl seem ? Some wl 78-79. 58 measurements with some errors. No Q
607320	**15:22: 0 S**	**15:17: 0 E**	**1130**	**41034**	**6,4/3,2**	**feb65-jun75**	**feb65-jun75**	**feb65-jul75**	**OK**	**CUNENE - MATUNTO (607320)**	**New rating OK/reconvert OK**
607322	16:44: 0 S	14:58: 0 E	1100	53254	5,0/2,3	jun62-mar75	jun62-mar75	jun63-oct74	OK	CUNENE - XANGONGO (607322)	level now OK, Olav made new rating from 333 measurements.
607323	13:13: 0 S	15:57: 0 E	1590	1765						CUNENE - SAMBOTO (607323)	
607324	**14:54: 0 S**	**15: 5: 0 E**	**1190**	**35636**	**6,9/3,8**	**jun62-jun75**	**oct62-jun75**	**jul63-feb84**	**OK**	**CUNENE - VILA FOLGARES (607324)**	Yearbook 72/73 says altitude= 1180,**new rating OK by Olav**
607325	13:27: 0 S	15:53: 0 E	1541	4811	?					CUNENE - GOVE II (607325)	Yearbook 72/73 says altitude= 1550
607326	17:21: 0 S	15: 4: 0 E	1230	3715						CUNENE - CHITATO (607326)	
607343	12:41: 0 N	15:47: 0 E	1550	1						CUNENE - CUSSAVA - CUSSAVA II (607343)	
607345	12:55: 0 S	15:44: 0 E	1600	537						CUNENE - CUNHANGAMUA - GONGOINGA (607345)	
607349	14: 1: 0 S	14:36: 0 E	1530	570						CUNENE - QUE - VILA BRANCA (607349)	
607350	15:11: 0 S	13:38: 0 E	1540	1						CUNENE - NENE - CHIBIA (607350)	
607354	15:23: 0 S	13:58: 0 E	1310	1						CUNENE - CACULUVAR - QUIHITA (607354)	
627401	11:40: 0 S	19:51: 0 E	1300	1044	12,0/?	oct65-sep71	oct65-sep71	sep65-mar71	OK	ZAMBEZE - LUMEGE - CANHANGUE (627401)	completed level, 110 measurements, funny but OK rating.
627402	**11:55: 0 S**	**20:27: 0 E**	**1160**	**2970**	**7,9/?**	**oct65-sep68**	**oct65-sep68**	**oct65-jul68**	**OK**	**ZAMBEZE - LUENA - CHAFINDA (627402)**	**made rating, completed years.**
627403	11:48: 0 S	19:56: 0 E	1250	450						ZAMBEZE - LUENA - LUSO (I.I.A.A. (627403)	
627404	11:50:17	19:48:17	?	?					?	ZAMBEZE - LUENA - LUSO O.P. (627404)	
637501	15:42: 0 S	17:28: 0 E	1130	38650	2.4					CUBANGO - CAIUNDO (637501)	
637503	15:33: 0 S	17:34: 0 E	1160	10020	1.7					CUBANGO - CUEBE - CAPICO (637503)	
637504	13:50: 0 S	16:53: 0 E	1450	262						CUBANGO - CACUCHI - CAMUE (637504)	
637505	14:22: 0 S	16:30: 0 E	1490	3720	4.9					CUBANGO - CUTATO - CUTATO (637505)	
637506	14:40: 0 S	16:54: 0 E	1380	9430	3.0					CUBANGO - CUCHI - CUCHI (637506)	
637507	15:33: 0 S	19:12: 0 E	1180	27100	?					CUBANGO - CUITO - CUANAVALE (637507)	
637508	13: 3: 0 S	16:22: 0 E	1540	1520	11.4					CUBANGO - CHINHAMA (637508)	
637509	17:28: 0 S	18:29: 0 E	1110	71960						CUBANGO - CHISSOMBO (637509)	seems good says Mr Petterson
637510	17:56: 0 S	20:42: 0 E	1040	59170	2.1					CUBANGO - CUITO - DIRICO (637510)	
637511	17: 2: 0 S	18: 9: 0 E	1120	70080	4,3/1,6	nov64-jul75	oct67-jul75	oct67-may71	ok?	CUBANGO - FOZ DO CUATIR (637511) fill in 64, year 66/67	Compare Yearbook 72/73 ??
637512	16:13: 0 S	17:41: 0 E	1120	50330	2.2					CUBANGO - MUCUNDI (637512)	
637513	14:40: 0 S	16:31: 0 E	1380	12570	?/4,0	oct68-aug75	jun68-sep73	may68-jul75	+	CUBANGO - MUMBA (637513)	needs new rating, and reconvert. More measurements in archive ?
637514	14:41: 0 S	17:22: 0 E	1385	5230	8,5/2,3	jun66-nov74	oct67-nov74	mar68-sep73	+	CUBANGO - CUELEI - MISSAO VELHA (637514) fill in 68,74	Yearbook 72/73 says longitude= 17:24:0 Rating ?
637515	14:41: 0 S	18:40: 0 E	1290	1770	4.1					CUBANGO - QUIRIRI - PONTE (637515)	
637516	**17:53: 0 S**	**20: 4: 0 E**	**1060**	**86800**	**3,4/1,2**	**oct63-jul75**	**oct66-jul75**	**oct67-jul75**	**OK?**	**CUBANGO - SAMBIO (637516) seems good.**	**103 measurements. New rating OK. Change of 0 oct66!**
637517	14:40: 0 S	17:42: 0 E	1335	4520	4.2					CUBANGO - CUEBE - NENONGUE (637517)	
637518	14:40: 0 S	17:41: 0 E	1350	1100						CUBANGO - LUAHUCA - SERPA PINTO (637518)	
637519	14: 7: 0 S	16:42: 0 E	1490	3020						CUBANGO - CUCHI - UNONGUE (637519)	
637520	14:29: 0 S	16:17: 0 E	1420	7320						CUBANGO - VILA ARTUR DE PAIVA (637520)	
637528	13:31: 0 S	16:32: 0 E	0	1						CUBANGO - CUTATO - JAMBA CUTATO (637528)	
637529	13:36: 0 S	16:39: 0 E	0	1						CUBANGO - CUCHI - JAMBA CUCHI (637529)	
637540	14:29: 0 S	16:17: 0 E	1420	7320						CUBANGO - V.ARTUR PAIVA (NOVA) (637540)	
43050202	9:29: 0 S	20:21: 0 E	1070	5410						ZAIRE - CHICAPA - SAURIMO (VERSAO A) (43050202)	
43050302	11:13: 0 S	20:12: 0 E	1260	5400						ZAIRE - CASSAI - PONTE (VERSAO A) (43050302)	
43050402	7:33: 0 S	15:49: 0 E	1120	1400						ZAIRE - CUILO -PONTE (43050402)	
60130102	7:45: 0 S	15: 5: 0 E	900	182						LOGE - LUQUIXI - BARRAGEM (VERSAO A) (60130102)	
60300102	12:17: 0 S	15:39: 0 E	1410	2887						QUEVE - ALTO HAMA (VERSAO A) (60300102)	
60300302	11:51: 0 S	15:22: 0 E	1340	9887						QUEVE - CAIOVOLE (VERSAO A) (60300302)	
60300702	12:22: 0 S	15:39: 0 E	1430	1						QUEVE - CUITO - CHITATAMERA (VERSAO A) (60300702)	
60300902	11: 8: 0 S	14:48: 0 E	1240	18304						QUEVE - GINGA (VERSAO A) (60300902)	Compare 603009 and keep the best from them in one series
63751802	14:40: 0 N	17:41: 0 E	1340	1						CUBANGO - LUAHUCA - SERPA PINTO (VERSAO A) (63751802)	

Important notes:

Notes from all Angolan hydrological stations studied in 8 weeks October 2003 – April 2004. Secondary stations and primary stations. The notes are meant to be updated by the hydrology staff in Angola parallel to their work updating their database. By Dec 2004, 125 stations.

400301 LULONDO-BUCUMAZE. Only studied in database. No time series are established. If we can't find historical data, this station should be excluded from our lists (and the database unless here are future plans).

400401 N'HAMA-LUCOLA-CABINDA. Only studied in database. Level and Q-data sep83-sep84. 7 measurements feb84-jul85. Adjust time series limits. Find more data.

430501 ZAIRE-CHIUMBE-DALA. Good red file. Area= 2153 km^2? (Database 2100 km^2). Start nov65 (constructed oct65). Level data are now completed 65-74. Compare 430503, and 430502. Level data nov75- oct77 are missing, and following data are too dubious for further work (?). There are no discharge measurements after oct73, and there has been a change of 0-level, approx 1 m from oct77. 139 measurements oct65-oct73. Rating 1965-67 is made (dubious F-period is unchanged). Level data 1965 – 1974 converted to flow series Caudais Medios Diarios. There is also a Daily Mean Flow series 1967-83, with estimated flow values after 1974. The quality of these estimated values is not known and documentation on the work behind the estimated values is not found.
D-MASS compare 430503 and 430502 is found OK.

430502 ZAIRE-CHICAPA-SAURIMO. Found OK, D-MASS compare 430503. Also has water level data 1977 – 1984. Is it possible to find even more data somewhere? Area is changed (now OK runoff compared to 430503).

430503 ZAIRE-CASSAI-PONTE is found OK, D-MASS compare 430502. New rating established.

430504 ZAIRE-CUILO-PONTE (ALFANDEGA) is found BAD (but may be looked closer at). Wrong rating. 0-level changed? Too much data lost? The complete years may be OK after a closer check, and some work. May be an important station to update (Lasse)!

430506 ZAIRE-LUACHIMO-SAMUPAFO. Only studied in database. Level data oct72-sep84, with gaps 75-78. Try to fill in. No Q-data, but 36 measurements. Make rating and re-convert.

430511 ZAIRE-MUANZANZA. Only studied in database. Area? Level data feb73-apr84, gaps 75-77. 0-level change in 1982? 48 measurements oct76-jul84! It seems challenging to make a rating from these.

430513 ZAIRE-CUILO-ALTO CUILO. Only studied in database. Level gaps 75-77. 20 measurements apr80-may82. Find more data.

601101 M'BRIDGE-LOA-FAZENDA LOA. Completed. Compare 601301 seems dubious. The much smaller area at 601301 gives larger Q. Compare 601701 to find out?

601102 M'BRIDGE-LUCUNGA-F.LUCUNGA. Only studied in database. One year of level data. More in archive?

601103 M'BRIDGE-SERRA DA CANDA. Only studied in database. Level gaps could be possible to fill. Any measurements?

601105 M'BRIDGE-LUCUNGA-STA LEOCADIA. Only studied in database. Level gaps could be possible to fill. Any measurements?

601301 LOGE-LUQUIXE-BARRAGEM. File # 8. Needs level completion in 1965, 1966, 1967 and 1968. Has 18 measurements mar68 –aug74 (seems OK), but there are a lot of measurements in the black file sep65-aug74. Only B-rating is present, needs new rating when all measurements are registered. Quipoco has started introduction of data 1965 – 1967. Data to find 73-74, and after? Adjust limits for level and flow.

601302 LOGE-FAZENDA LOGE. Only studied in database. Level data 68-74, but some errors and data lost (gaps 70-73 should be filled). Also some data in 1981-82. Check files for more data. Q or measurements?

601304 LOGE-FREITAS MORNA. Only studied in database. Level data 80-83 with big gaps. Check for more in archive.

601701 DANDE-PORTO CUIPIRI. Completed for its period and found OK.

601702 DANDE-CANHONGO-PONTE. Only studied in database. Adjust limits. 0-level change in 1969? Q higher and higher by time? 55 measurements. Need better rating.

601703 DANDE-MAMBULO-PONTE. Only studied in database. Unstable profile? Also has level data 81-83. 50 measurements. Need better rating. Area 250 km^2? (25 km^2 gives runoff about 80 $l/s*km^2$ for 67-68).

601704 DANDE-MAMBULO II-QUEDAS. Only studied in database. Level is possible to make good. 12 measurements (some with wrong stage, or are all at 1,40 m?).

601706 DANDE-PONTE DE QUIBAXE. Completed for its period and found OK.

601804 BENGO-CABIRI. Completed for its period and found OK.

601806 BENGO-LALAMA. Completed for its period and found OK.

601810 BENGO-ZENZA-FAZENDA BOM JARDIN. Is found BAD. There is not enough data. The quality of the data found is not checked. Change of 0-level sep72. If another station is needed in Bengo try 601805.

601901 CUANZA-LUANDO-AFLUENTE DO COLE. File #27. Area 2990 km^2 or 2103 km^2? Level data jan64-sep65 seems OK, and here are some level data oct68 who are wrong. No measurements in database (and no time series established for measurements). Q-data oct67-sep74 (nothing between 0 – 1 m^3/s?), see aug72-oct72. Can we find more level data, Q-data or measurements? See SONEFE-books.

601902 CUANZA-BOM JESUS is OK. But tidal effects do that only water level is registered. The compare station 601909 is also completed – and so far only level is found here too. The level registration for both seems good.

601903 CUANZA-CUTATO-BANGA. File #29. Level data may64-sep67 seems OK. No measurements in database (and no time series established for measurements). Q-data oct67-sep74 can be OK, compare 601917 and 601957. Can we find more level data, Q-data or measurements? See SONEFE-books.

601904 CUANZA-LUINGA-BACUANGA. File #30. Level dec62-sep65 is complete and corrected. No measurements in the database (and no time series established for measurements). 601918 is OK as compare station. Q-data oct67-sep74 seems OK (a few small corrections made). Area too big? Compare 601918 the area can be OK, but for these small areas the precision is very important. Can we find more level data, Q-data or measurements? See SONEFE-books.

601905 CUANZA-CUANZA (POVOACAO DO CUANZA). File # 31. Level data with short missing periods 59-69 (missed data in 1962 and 1969). Q-data oct67-jun72. No measurements in database. Can we find more Q-data or measurements? See SONEFE-books. Wrong area or Q-data (compare 601903), or is it just drier in this part of upper Cuanza?

601906 CUANZA-CAUISSO. File # 32. More level data in archive than in database. No measurements. Q-measurements from SONEFE? Q-data missing in mar-apr69 (could be constructed using compare station 601908 and 601935). Q-data from SONEFE. Some small corrections done (see July 1969, jan-mar70). Some high Q-data can be wrong from "mirror-levels".

601907 CUANZA-CAPANDA. File # 33. More level data in archive than in database, 66-69. The rest of the years (70-75, 77-82) must be checked for unnecessary missing data. There are a few obvious errors. Only 12 measurements from 1987 in database, and I can't find any measurements in red file. No flow series established.

601908 CUANZA-CAMBAMBE. File # 34. Compare 601936 and 601944. Good red file. Lots of data in archive. NB all level data oct59-sep72 was in 60190802 versao A and was transferred to 601908. 60190802 Versao A was deleted. Good level compare station is 601909 and or 601902. Dubious water level data in oct61-jan62. Missed level oct64-mar69. There are some un-introduced level data in the archive files. No real measurements in database before 1969 (total of 48 measurements 63-04, 13 real measurements). A lot of Q-data in the red ARCHIVE file, but only 67-72 + 87-89 in the database. THIS SERIES ON Q SEEMS POSSIBLE TO COMPLETE FROM 1952 – 1972, AND MAYBE A FEW YEARS LATER (but it seems you have to register Q-directly into the database (started introduction 31.03.2004)). Q-data from SONEFE. **Flood 1-apr-69, 3740 m^3/s – 31 l/s *km^2.**

601909 CUANZA-CABALA. File # 35. Left out of the station list by Paulo Emilio. It seems a valuable series to me. Completed water levels 1956-1971. Confirms data at 601902 (Bom Jesus).

601913 CUANZA-LUCALA-CATECO CANGOLA. File # 39. Level data jan64-sep64 completed. Also level data 1978-1983 with some gaps and errors (some interpolation done and some errors fixed). 9 measurements may78-mar79, no rating made. Incomplete Q-data oct67-sep74 (dubious data in long periods, compare 601946). Look for more data.

601915 CUANZA-LUVULO-CAPOLO. File # 41. Area 45 km^2? Level data feb67-mar71. Missing values in 69/70. No measurements, but one A-rating. Q-data in the same period as level data. The few gaps should be filled in.

601916 CUANZA-CUNHINGA-CAPEIO. File # 42. Area too small? Level data oct65-sep66, seems OK. But here is only this year. No measurements. Q-data oct65-jun75 (missing feb-apr 1975). Q-data completed and corrected oct65-sep74 by compare 601926.

601917 CUANZA-CUTATO-CUTATO ANDULO. File # 43. Area too small? Compared to 601903 and 601905 the real area could be up to 20000 km^2, but compared to 601957 it seems all right?!!? Level data aug59-may66. Suspicious values last half of nov59. Change of 0-level nov60 (80 cm). Missing mar-may 1960. New change of 0-level jul61 (50 cm?). Level data completed, except mar-may60 and may-sep66 (jan62 fixed by compare, and the rest interpolated). No measurements. Q-data oct67-sep74 is completed, and corrected. Compare 601957.

601918 CUANZA-BUINZA-CALOMBO. File # 44. Compare 601904. Level data dec62-sep66, with gaps oct-dec62, oct-dec64 and aug-nov65. No measurements. Q-data oct67-sep74, with the only missing period nov67-dec67. Area too big?

601920 CUANZA-CUQUEMA-CHAVAIA. File # 46. Compare 601921 & 601957. Level data oct66-nov69. Gaps oct and nov 1969. 26 measurements feb68-sep69. A lot of measurements 1966-1968 are not introduced (see red file). Q-data oct67-sep69 (data missed in dec67, why – how could that happen? Are some data directly introduced, other data converted in the same time series?). At least one year of data can be added. New rating must be made, and reconvert

601921 CUANZA-CUQUEMA-CHIMBUNDE. File # 47. Compare 601920, 601957, and 601922. Level data may64-sep72. NB 0-level change from oct66 (80 cm). Lost level data dec67, mar-may69, 69-70 & 70-71. No measurements. Q-data oct64-mar75 (lost data dec66, mar69, error mar 71, error 1972-see jun72, error may-jun73, lost nov74). A candidate to be stamped as BAD if no more information is found in SONEFE-books.

601922 CUANZA-CUNJE-CHIMBUNDE. File # 48. There are a lot of possible compare stations in this area, in the same sub-catchment of Cuanza - 601915, 601943 and **601928** and in neighbouring sub-catchment - 601921, 601954. Level data may64-sep68 (lost data dec66-jan67), a few corrections made. No measurements. Q-data oct68-apr75 (dubious feb-mar70 (from "mirror-level"), aug73, mar-apr74). The quality all in all does not seem convincing.

601923 CUANZA-DONDO. Left out by Mr. Mendes. File # 49. Has water level data 1954-1982. No measurements and no Q-data in database. A lot of measurements and Q-data in red file. Q-data 1954-1958 should be possible to get out, and there may be more data both in the black files and SONEFE-books. Could confirm and complete 601908 Cambambe

601924 CUANZA-L.CATETE-DOMBO. File # 50. Left out by Mr. Mendes. Valuable compare station for 601958? If the area is 58 km^2, that makes this a valuable station. Level data 63-69 (gap 69-72). Q-data? Search in archive and SONEFE-books.

601925 CUANZA-MUCOSO-DANGE IA MENHA. File # 51. Area 1231 km^2 or 1280 km^2? Compare 601952, 601953. Level data oct64-aug70 (lost data nov64-sep65, oct65-jan66, aug66-nov66, - too many data lost and too many errors). Level data BAD. No measurements. Q-data oct64-sep74 (data lost des64-oct65, jul-aug71, nov72-apr73, apr73-oct73). Nothing between 0 – 1 m^3/s (no decimal resolution in this small area!). The Q-series need a lot of work – if it ever can be – to be reliable.

601926 CUANZA-CUNHINGA-FOZ. File # 52. Area? Level data may64-sep69. Change of 0-level 1968 (around 40 cm?). Level data missing mar-sep 1968, but there is Q-data in the period (in red file). No measurements. Can we find measurements 1964-1968? Q-data oct68-sep74 (missing mar70-sep70, and feb72-aug72). Apart from 1970 and 1972, Q-data completed and corrected.

601927 CUANZA-LUA-FOZ. File # 53. Compare 601918 (should find better). Level data dec63-sep70 (data lost jan-apr65, apr-aug65, 10 cm error apr-may69?). No measurements. Q-data oct67-sep72 (small error apr68 from "mirror level"). Q-data seem periodically dubious to me. Check **area** in SONEFE-books.

601928 CUANZA-CUNJE-CAMACUPA. File # 54. Good compare station in 601922 (same river). Level data oct64-aug72 (lost data nov70-jan71, aug-oct71, nov71-jan72). Level data 1964-65 is completed by interpolation between level values from measurements. 45 measurements oct67-jul71, but here are more measurements in the red file – and further possibilities for even more in black files and in SONEFE-books. Measurements in red file from jun64-1968 should be introduced, and give Q-data 1964-1967. Three rating periods (0, 1&A) must be rechecked (no rating 75-76). Two time series of Q-data (caudais & daily mean flow) – go for one of them!! The caudais has Q-data 67-68 and some data 70-71 and 71-72. The daily mean flow has Q-data from jul65-aug72 (short periods missing in mar66, apr67, dec67-feb68 with errors, 68-69 with errors, oct69, mar70, nov70-jan71, aug-oct71, nov71-jan72).

601929 CUANZA-GANGO-GANGO. File # 55. Compare 601962. Level data aug59-sep66 are complete (small errors fixed, completed jul65, still dubious jul-aug63). Look for more level data to introduce. No measurements introduced. Q-data 67-74 (periods with higher Q here than at downstream 601962, missing nov-dec68, sep71, jan-feb74 and mar-apr74). Should be created by converted level data.

601930 CUANZA-LUCALA-Km 34. File # 56. Compare 601931. Lots of good information in red file. Area 25290 km^2 or 22620 km^2 (see red file). Level data completed and corrected may54-apr59, missing apr-sep59, dec59-apr60, 60-61, and completed/corrected oct62-sep64. No measurements (no time series established). Lots of measurements in red file (back to 1940). Look for measurements in SONEFE material.
Q-data oct67-sep74 (corrected/completed apart from errors from mirror level feb-mar68 and the missing oct71-aug72). Compare station 601931 up-streams sometimes show larger Q than here (dubious rating behind Q-data), but since the area between the stations probably is only 3000 km^2 (not 6000 km^2 as it says today) these errors may be considered neglect able.

601931 CUANZA-LUCALA-LUCALA. File # 57. Compare 601930. Lots of good information in red file. Level data jun54-sep66. Needed a few corrections, was complete. Also has some level data feb78-may83, with some short missing periods. No measurements (time series established, but no data)/no rating, but here are measurements in red file and possibly in SONEFE-records. Q-data oct67-sep74, complete (a few corrections done). Database says Q-data till sep75, if so – oct74-sep75 is missing. There is more Q-data in red file. About Q-quality, see comments on 601930 (Q should not be larger here than at 601930).

601935 CUANZA-LUANDO-LUCUNGA. File # 61. Compare 601901 and 601906 (none of them really good). Little information in red file apart from data. Level data dec62-sep66, seems complete and OK. No measurements in database. Q-data oct67-sep74, but more should be possible to introduce. Q-data in database seems OK (?).

601936 CUANZA-MUTULA. File # 62. Compare 601908, 601944 and 601955. Level data dec62-sep64 (more in SONEFE-records?), completed/corrected. No measurements introduced and no rating (but time series is established). Q-data dec62-apr75 completed and corrected. Q-data seem very good along compare stations. Possibly could even more data be introduced? **Valuable station!** D-MASS against 601955 OK.

601938 CUANZA-MUXIMA. File # 64. **Not in our list from the start.** Red file with lots of info and data. Seems possible to get a lot of information from. Only level data? 152000 km^2, means that it is laying close to 601902 Bom Jesus, so …. Almost complete level data oct57-sep82. Look for more data – especially for Q-data. SONEFE ?

601942 CUANZA-N'HAREA. File # 68. Compare 601905 and 601906. Level data jan63-sep65. Level data seem OK for these years. No measurements (no time series established for it). Q-data completed and corrected jan63-sep75. **Looks good!**

601943 CUANZA-CUNJE-CATABOLA. File # 69 (marked **NOVA SINTRA**). Compare 601922/601928. Level data completed and corrected oct65-nov74 (also introduced oct66-apr67). Seems good in compare. Limnigraph from oct65. Different levels escala/limnigraph. 192 (introduced 91 now) measurements jul64-jul75. Measurements and ratings are checked. B-rating introduced for oct65-sep67. New A-rating made for oct67-sep81. A lot of the high measurements had remarkably bad fit to the old A-rating (they still don't fit very well). A two-segment solution should be tested. The profile has been solid. The new rating gives all over better fit of the measurements. **Q-data oct65-nov74 should be good. Flood 69, 140 – 150 l/s*km^2.**

601944 CUANZA-CANGANDALA. File # 70 (marked PONTE SALAZAR). Lots of info in red file. **NB the red file also contains measurements from other stations in Cuanza.** Compare 601908 and 601936. Level data oct56-sep68 (missing sep58-oct62, oct65-sep66). Also data oct79-sep82 and 88-89. All registered level data seem OK (some correction and completion made). 12 measurements "jun65", gives one rating 1965 – 2002? And especially the high values have a bad fit (measurement results 30 % away from the accepted rating). It does not seem like the existing Q-data are converted level data over this rating. I suppose the Q-data are directly introduced. Q-data oct67-sep73 (missing oct69-sep70). Also has some Q-data oct79-sep82 and oct88-sep89. All Q-data completed apart from 69-70 and mar-may80. **Q-data seem promising!**

601945 CUANZA-CUIVA-P.FREITAS MORNA. File # 71. Compare stations 601922, 601954. Level data feb63-sep69, completed. No measurements (no time series established for it). Q-data oct63-sep74 (dubious mar71, missing 72/73). Look for more data! Flood 69, 230 m^3/s – 44 l/s*km^2.

601946 CUANZA-CUIJE-PONTE DO CUIJE. File # 72 (no black file found). Compare 601913. Level data nov77-sep82 (dubious 77/78 may be mirror level, but fits with measurements (real measurements?), missing apr80, oct80) - completed apart from the mentioned missing. **49 measurements dec77-oct83!! Measurements in this period are rare. The rating has to be adjusted,** and you probably will need the original measurements to find the correct measurement values. Two time series (caudais and daily flow 77-83). Q-data (caudais) oct67-sep74 (missing oct-nov68, oct71-jul72, dec73-feb74). It seems we also here may have some errors from misjudged "mirror-events" in the level data. The daily flow (77-83) should be done on a new and better rating.

601949 CUANZA-COLE-POUSADA DO DUQUE. File # 75. Compare 601950. Level data jun59-sep64 (with obvious errors, periods of 1 m too low). No measurements (no time series established for it). Q-data oct67-sep74 (error oct-nov68, feb70, feb-mar73). Otherwise this could be OK.

601950 CUANZA-LUCALA-PONTE RAUL LIMA. File # 76. Compare 601949 and the other stations in river Lucala. Level data jun59-sep64 (missing 60/61, meter error feb-apr64 + other missing periods). No measurements/no rating (but a time series is established for it). If we can find measurements 1959 – 1964 we can add some years of hydrology in upper Cuanza. There are also some level data dec78 – sep83. We miss data oct64-sep67 (SONEFE?). Lots of info in red file. Q-data oct67-sep74 (error apr-jul71, feb-mar73).

601951 CUANZA-LUCALA-P.VIEIRA MACHADO. File # 77. Lots of info in red file. Compare 601950. No level data. No measurements (no time series established for it). Q-data oct67-sep74 (error feb-mar73). At least 61-67 can be introduced (see red file). The area 11891 km^2 is also seen.

601953 CUANZA-LUCALA-PONTE PINHEIRO CHAGAS. Compare 601950. Level data jun59-sep67 (missing mar-jul61), but level data seem OK here. There are also some level data jan78 – sep82. No measurements (no time series established for it). Q-data oct67-sep74 (complete and possibly OK), but you may find more in SONEFE-books or files.

601954 CUANZA-COQUEMA-PONTE DA CAMBANDUA. Level data jan63-sep66 (many data missing). No measurements, no rating. Q-data jan63-jun75 (missing jun-aug67, nov67-sep68, oct68-may69, jul-sep69, oct69-may72, jun-dec72, apr-may73). Too many missing periods for further work (?).

601955 CUANZA-QUISSAQUINA. File # 81. Level data 09.04.1964- 30.09.1964, a lot more in archive. No measurements. Q-data from SONEFE apr64-sep75 (missing mar-may65, aug65-may66, a few values 1968 corrected). Good compare station is 601936. Q-data in database seem good (apart from missing periods). D-MASS against 601936 OK.

601956 CUANZA-CUNE-QUEDAS DO LAU LAU. File # 82, has good information, and data that may be introduced (measurements). Compare 601916 **(in the same river?).** Level data aug59-sep68, (missing jul-dec60, apr62, error sep62, oct-nov64). Be aware of 0-level changes, especially in the first years (around 50 cm), and it seems some short periods with 10 cm errors. No measurements (no time series established for it). Q-data oct68-sep74 (a few errors fixed), complete. Seems OK. Area? More data?

601957 CUANZA-CUTATO-QUEDAS. File # 83. We miss level data oct66-sep67 (SONEFE?). Sep73 and sep74 are filled in by Arnt. No measurements. Q-data oct67-sep74 is complete.
Area compared to 601917 and 601903 seems all right. 601905 is perhaps in a much drier area.

601958 CUANZA-JOMBO-RIMBA LUQUEMBO. File # 84. Compare stations 601911, 601912 and 601924 (all are left out by Mr. Mendes, and have only level data in the database). Level data nov60-sep66 (gaps in 60/61). Also data 77-82. No measurements (no time series established for it). Q-data oct67-sep73 (bad 73/74). More Q-data can be introduced from red file (61-67).

601962 CUANZA-GANGO-VILA VERDE. File # 88. Compare 601929. Level data dec62-sep66, complete. Look for more level data to introduce. No measurements introduced. Q-data oct67-sep74 complete, but dubious compare to the upstream 601929.

602501 LONGA-NHIA-BUIA. File # 94. Compare 601502. Level data oct64-sep81, with a few missing periods after apr75 (error nov69). The period before 75 seems OK apart from nov69. 101 measurements oct67-apr81. Constructed a new F-rating 76-81. The E-rating didn't fit at all. **NB! Water level data not re-converted, because I think this series need even more work. There is need for an extra rating in the period oct75-sep77 that has other 0-level than the periods before and after.** Q-data in two series. The two are identical for oct67-sep73 – and the data in this period seem OK in compare studies, but do probably need re-rating. Possibly is 73/74 also OK – and at least years before oct67 should be possible to add without too much work (but you should find some measurements for the years before 67).

602502 LONGA-NHIA-CASSONGO. File # 95. Compare 601501. A lot of info in red file. Level data oct64-sep81 (missing oct65-sep67, and several short periods after apr75). The period before apr75 is OK, apart from missing periods. 57 measurements oct69-sep73 (more in red file). Especially the J-rating 72-73 should be re-done. Q-data cannot be trusted before new rating periods are made – and level data re-converted.

602503 LONGA-CARIANGO. File # 96. Level data from oct69-sep74 (needs to be completed). 58 measurements nov69-sep73. Especially B-rating needs a change. Q-data oct69-sep74 cannot be trusted (may be OK in 69-71).

602505 LONGA-CATOFE-CATOFE. File # 98. Lots of info in red file. Compare 601503. Level data oct64-sep71, change of 0-level before 70/71 (missing jul-oct70). Complete apart from this missing. No measurements, but three rating periods – can they be trusted? Look for level data and measurements – and introduce what you find. Q-data cannot be trusted (?). Q-data oct67-jun70 (too low?).

602506 LONGA-QUISSUCA. File # 99. SONEFE? Water level missing in dec67, feb68, 75, 76, 77, 78, 79, 80. 114 measurements (or more, must be checked) feb68-mar81. Needs new rating. More data to introduce.

602507 LONGA-QUILONGA. File # 100. Some info in red file. Flight photos and maps. Level data aug70-may74 (missing periods 73/74). More data to introduce. 35 measurements. Needs new rating. Q-data 72/73. New rating and re-convert.

602508 LONGA-CATOFE-FABRICA. Wrong area. Needs new rating. More than 60 measurements (check for even more in archive).

602510 LONGA-POMBUIGE-TARI. BAD – if the archive hasn't got more data. Only two years of data in database 73-75. 17 measurements. Coordinates OK 11.03.2004. No area, dubious elevation. The only information in red file is photos from the construction period, probably in 1973.

ALL THE STATIONS IN LONGA NEED A LOT OF WORK BEFORE THEIR DATA CAN BE TRUSTED. AN ALTERNATIVE TO NEW RATING IS TO INTRODUCE ALL THE ORIGINAL Q-DATA FROM THE ARCHIVE FILES. BUT GIVE THE ORIGINAL Q-DATA UNIQUE TIME SERIES NAMES.

603001 QUEVE-ALTO HAMA. Left out by Paulo Emilio. Consider taking it in? Change area. Seems to have OK water levels. Fill in a short per 65. Look for more level data. 84 measurements mar68-sep74 (look for more). Needs new rating (especially on high levels, and probably more than one rating period). Reconvert.

603003 QUEVE-CAIOVOLE. Level data seems complete 64-73 (look for more). 65 measurements oct67-sep73. Check for more measurements in archive. Needs correction in some measurements (level=0.00 m) and probably a better rating for high levels. Reconvert.

603004 QUEVE-CACHOEIRAS DA BINGA. Completed and made new rating. The old rating was awfully wrong because of wrong measurement water levels. Data in DNAs annual reports cannot be used! **OK D-MASS** compare 603009. **Introduce original flow data from archive to double-check.**

603006 QUEVE-CUCHEN-CATATO. Water level is not completed. Look for more data in archive. Needs new rating, and reconvert. More measurements in archive?

603007 QUEVE-CUITO-CHITATAMERA. Suspect data, check rating. Two Q-series

603008 QUEVE-COVOLE-GONGO. Fill in water level 69,73,75 (short periods), check for more. 85 measurements oct67-jul75, check for more. Needs new rating. May go with one rating period, but should adjust on high levels. Correct the limits for time series, Q cannot reach 100 m^3/s here.

603009 QUEVE-GINGA. Level completed and corrected. New rating OK. **OK D-MASS** compare 603004.

603010 QUEVE-CHILO-HINCHINGO. Only studied in database. Level data jan65-sep83, with gaps 75-77. 92 measurements dec67-jul75, look for more. Needs better rating. And look for original Q-data.

603013 QUEVE-CUVOMBUA-LUBIRI. Only studied in database. Adjust time series limits. Almost complete water level data 70-75. 74 measurements 70-75 (some corrections needed). Need new rating. No Q-data in database.

603016 QUEVE-CUVIRA-TRANGALA. Only studied in database. Adjust time series limits. Almost complete water level data 65-70. 29 measurements 67-71. Need new rating. Q-data in database from 68-70.

603017 QUEVE-CUSSOI-TACANHO. Only studied in database. Adjust time series limits. Almost complete water level data 66-75. Find measurements or Q-data.

603018 QUEVE-CULELE-VINGANGA. Only studied in database. Adjust limits. Level data 65-73 need correction. New rating needed. 41 measurements 68-75. Can you find original Q-data?

603019 QUEVE-CANINDA-VERGANISTA. Only studied in database. Adjust limits. Dubious level data 71-75. New rating needed. Check measurements at stage 1,88 m. Can you find original Q-data?

603020 QUEVE-CUNHANGAMA-CAPOCO. Only studied in database. Adjust limits. Level data 69-75 need some correction, but looks hopeful. Rating needed. Measurements 67-75. Can you find original Q-data?

603021 QUEVE-JANGADA-NOVA LISBOA. Level 65 – 68 seems OK (short periods missing). Measurements are not registered. Check archive for more level data and measurements. BAD if nothing more is found in archive.

603023 QUEVE-CALONGUE-SAMAINA. Suspect level data (check if they are useful before you do anything more). Awful rating, but 75 measurements. New rating if level data are found OK. Check for more data in archive.

603101 N´GUNZA-GANJA. Level data seem OK may65-jul75, needs fill in 75,76,77,78,80,81. Look in archive. Look also for the correct measurement data and for more measurements, correct measurement 64 (1.60 m= 5,9 m^3/s, probably 1.06 m). Check rating (seems OK) and reconvert when level data are completed. Has two Q-series today. Potentially a good series. Area?

603201 QUICOMBO-CATANDA. Only studied in database. Adjust limits. Level data 64-75, with gap 66-67. New rating needed. 103 measurements 67-75. Can you find more measurements or original Q-data? Area? (See 603202, below).

603202 QUICOMBO-QUICOMBO. Level data lost from HYDATA when establishing series for 1-hour data (2003)? These should be put back, and completed as far as possible. 111 measurements in one rating period. The measurements after 1976 do not fit this rating. Needs new rating and reconvert of level data. At the same time check neighbourhood upstream stations (I think it was in the annual report I saw that an upstream station had higher flow).

603403 EVALE-LOETO DESCARREGADOR. Water level registrations seem hopeless (adjust time series limits). Better data in archive? Better data in DOS-version? No measurements registered (no time series established for measurements). May be trying 603402?

603501 BALOMBO-CAPECO. Only studied in database. Adjust limits. Level data 64-70 need correction and work. New rating needed. 23 measurements 68-70. Can you find more measurements or original Q-data?

603502 BALOMBO-CANJALA. Water level needs fill in 67,70,71,72,73,74,75 – and may find more data in archive. 112 measurements are registered dec67-jun81. Needs new rating. More than one rating period needed.

603504 BALOMBO-CAPECO MOINHOS. Only studied in database. Adjust limits. Level data 70-75 almost OK. Rating needed. 75 measurements 70-76 (the last one is probably in 1975). Can you find more data? Original Q-data?

603701 CUBAL DA HANHA-HANHA. Water level needs fill in 65, 69, 74, 75, 76, 77, 80 and 81. The start in 64/65 is based on other 0-level than the rest of the data. Water level also needs some obvious correction (not much?). 63 measurements from feb68-sep73, more in archive? Measurements # 56 – 63 needs correction (level?). Needs new rating. It seems like more than one rating period is required.

603801 CATUMBELA-BIOPIO. Only studied in database. Adjust time series limits. Only some small work needed on level data 62-74. Q-data seem promising, but only 37 measurements 63-64 in the database. We should find more measurements. Needs a better rating on more values.
Flood 21-Mar-1969= 1135 m^3/s – 72 $l/s*km^2$ (?).

603802 CATUMBELA-CAIAVE. Only studied in database. Adjust limits. Level data 62-71 are complete. Does this station need a new rating every year? One rating in database, no measurements !! Are original Q-data introduced? Q-data 67-71.

603803 CATUMBELA-CUIVA-CUIVA. Only studied in database. Adjust limits. Level data 62-71 are complete apart from gap 67-68. 0-level change? No measurements. Check the archive for more data. Can you find more measurements or original Q-data? The database does have Q-data, where did they come from?

603804 CATUMBELA-CUBAL DA HANHA-CUBAL. Only studied in database. Adjust limits. Level data and Q-data 62-71 are complete. 0-level change in 67-68? No measurements, but one rating 67-71, - ?? **I guess original Q-data are introduced. I would prefer original Q-data introduced in unique time series.**

603805 CATUMBELA-CUBAL DA HANHA-CAIAVE. Only studied in database. Adjust limits. Level data 62-71 are complete. Q-data 61-71 have gap 62-67, why? No measurements.

603806 CATUMBELA-CHICUMA. Only studied in database. Adjust limits. Level data 62-71 are complete. Q-data 67-71 have gap 1970, why? Are these Q-data converted? No measurements, but one rating for 1967-2002. Check rating. Find original Q-data.

603807 CATUMBELA-LUPOMBA. Only studied in database. Adjust limits. Level data 62-71 are almost complete (some obvious errors). Q-data 67-71 seem to be converted via one rating. Correct levels and reconvert? Introduce original Q-data in a separate time series if you find any.

603808 CATUMBELA-LOMAUM. I find it funny that Q-period is nov61- sep70, when water level period starts in feb62? I guess the Q-series is a mixture of converted and directly introduced data? Quipuco introduced measurements 23.03.04 (apr63-sep67). Look in the archive for more data, and check DOS-version or backups for "lost" measurements. Water level seems complete but needs a few obvious corrections. Area 11560 km^2 or 8296 km^2? Adjust time series limits.

603809 CATUMBELA-BIOPIO-II. No historical data ?? See 603801 (same location/ coordinates?).

604603 COPOROLO-DOMBE GRANDE. Water level seems good oct52 – jun64 (some obvious corrections needed). Much data loss 1964 – 1983, but you may find more in archives? 25 measurements registered jul73-nov76, there must be more (somewhere)!! No data in the discharge series. If no more measurements are found, you will have to trust the old ratings that can be found on data paper in the archive – if not the series must be stamped BAD.

606701 BERO-TAMPA (DESCARREGADOR). Only three months of level data? Is the rest lost? Check backups, DOS-version, or the archive. No measurements registered (descarregador). No Q-period. If we can not find more water level data, this series will never be useful (BAD?).

607310 CUNENE-CALAI-CHISSOLA. Has complete level data oct66-jul75. Level data 78 – 83 seems dubious. Two Q-series. 79 measurements oct68-sep73 registered. Can we find more measurements? Check and probably make new rating, and decide a final Q-series and its period.

607314 CUNENE-JAMBA IA HOMA. Good (?) and complete levels des63-sep72, dubious level data 73 – 75. 90 measurements oct67 – jul75. Can we find measurements 63-67? Rating must be checked, seems dubious on high level. Wrong area in DNA yearbook (at least yearbook 72/73).

607315 CUNENE-JAMBA IA MINA. Only studied in database. Almost complete water level. Bad B-rating. Find more data!

607318 CUNENE-CATAPI-LUCEQUE. Only studied in database. Water level seems dubious. Some level data 78-79. 58 measurements (some obvious errors). No rating, no Q.

607320 CUNENE-MATUNTO. Completed. In my knowledge there are no more data to find in DNA archive in Luanda. Water level 1976 – 1980 is found dubious and a lot of fill in is needed, and since we find no measurements in the period we should not use these for converting to Q. New rating was made, and reconvert is done. Stop date for rating should be changed to 30 Sep 75.
Found **OK, D-MASS** compare 607322 and 607324.

607322 CUNENE-XANGONGO. Completed. In my knowledge there are no more data to find in DNA archive in Luanda. Water levels 1978 – 1980 are not completed, and should not be used for converting to Q. Time series h-max should be adjusted. New rating is made from 333 measurements. Stop date for rating and Q-series should be changed to 30 Sep 75. Found **OK, D-MASS** compare 607320 and 607324.

607324 CUNENE-VILA FOLGARES. Completed. In my knowledge there are no more data to find in DNA archive in Luanda.
Water levels 1976 – 1983 are not completed, and seem dubious, but can be used for converting to Q, since we have found measurements for the period. New rating is made. Found **OK, D-MASS** compare 607320 and 607322.

627401 ZAMBEZE-LUMEGE-CANHANGUE. Completed. Unusual ("funny") rating, but it seems OK against the 110 measurements.
Found OK, D-MASS compare 627402.

627402 ZAMBEZE-LUENA-CHAFINDA. Completed. Made rating. Only 3 years of valuable data, 65-68. Found OK, D-MASS compare 627401.

627404 ZAMBEZE-LUENA-LUSO O.P. Coordinates now OK (?).

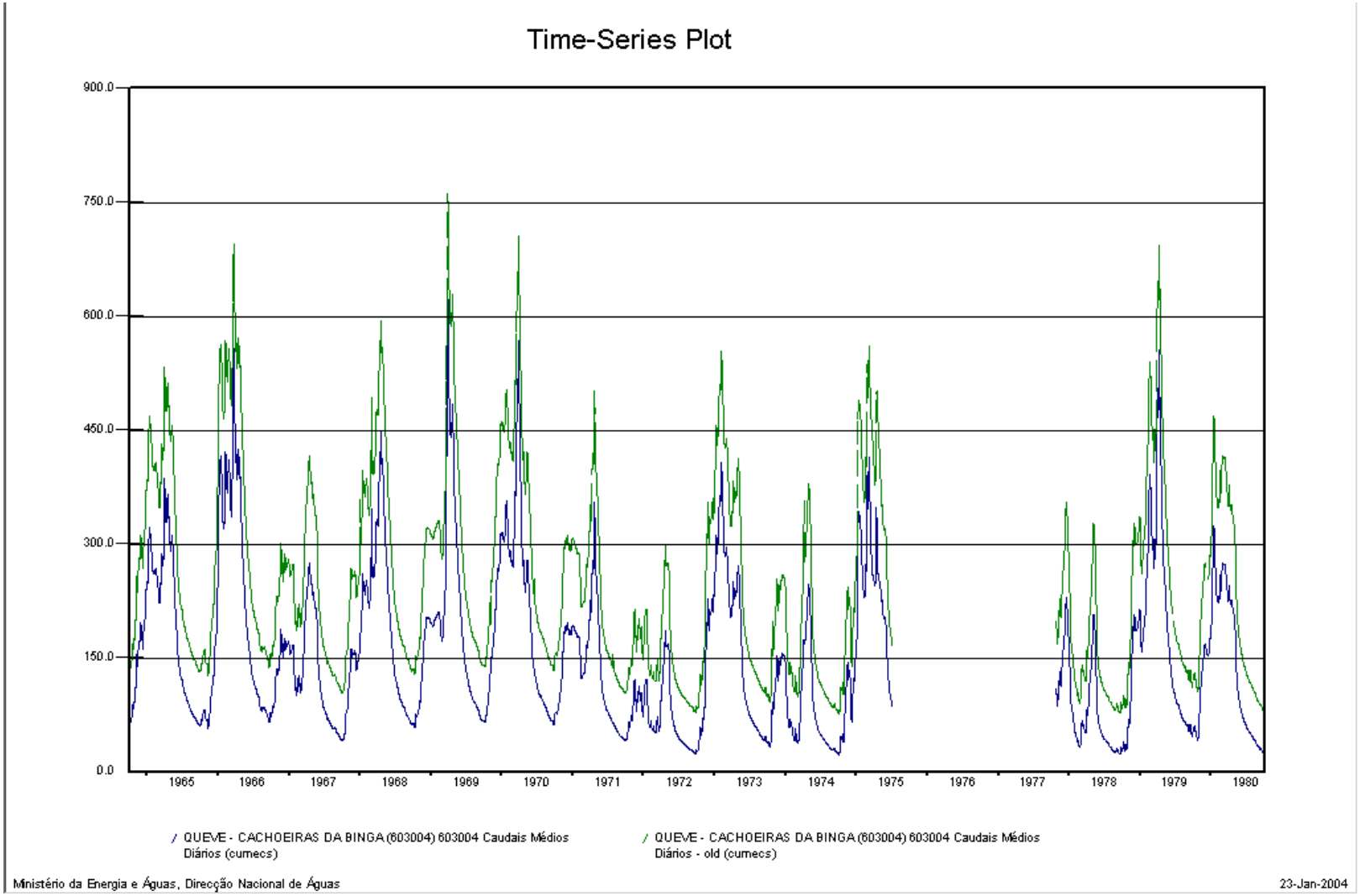
637511 CUBANGO-FOZ DO CUATIR. Not completed. Fill in water level a short period in 64, and year 66/67. 47 measurements in database oct67-may71. Check archive for more data, more measurements especially valuable. Potentially a good series for compare 637516 (D-MASS 1966-1975 seems OK). Check rating anyway.

637513 CUBANGO-MUMBA. There has to be more water level data since Q-period starts jun68 and level starts oct68. Needs a full check for more data in archive. Needs new rating and reconvert. Adjust time series limits (much too low upper limit for Q). Water level in database seems complete.

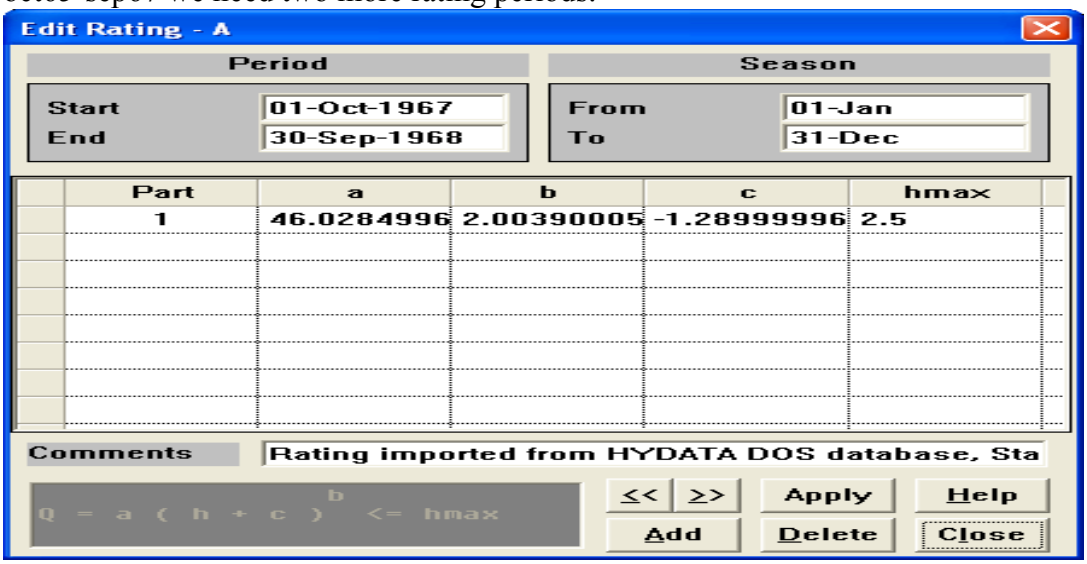
637514 CUBANGO-CUELEI-MISSAO VELHA. Level data jun66-nov74. Check for more. Adjust limits (10 m too much). Fill in 68, 74 (short periods). 71 measurements mar68-sep73. Short period for A-rating – look for more data and check rating.
Adjust limits for Q (is set too low, try 150 m^3/s). Should have Q-data at least from jun66? Reconvert.

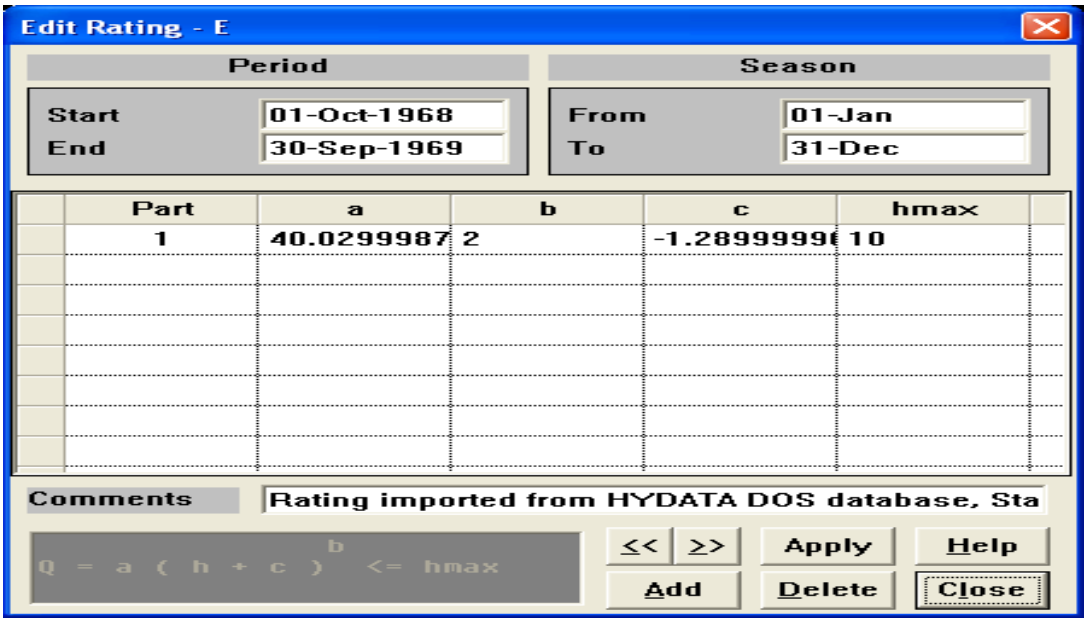
637516 CUBANGO-SAMBIO. Completed, but can we find more data somewhere? Made new rating from 103 measurements. Can we find measurements 1963-1966 somewhere? Change of 0-level in oct66. Q oct66-jul75 seems good. Possible compare station is 637511 (D-MASS 1966-1975 seems OK).

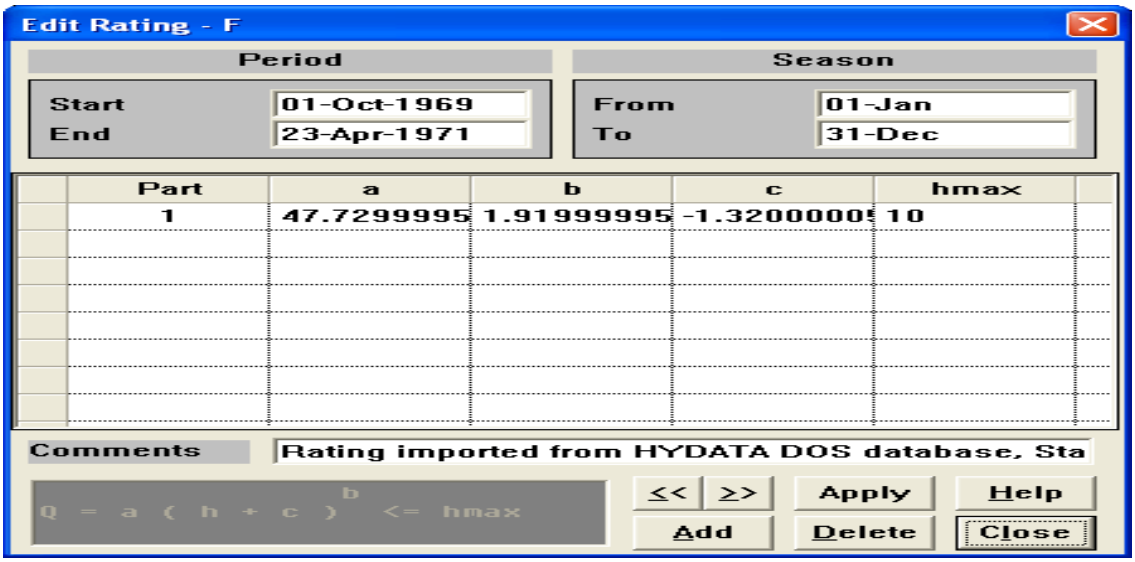
603004- QUEVE- Cachoeiras da Binga, compare of cumecs after old (green) and new (blue) rating.
Rating curve 603004, NEW! Based on 109 measurements in the period dec67-jun74. All measurements are registered and used, most were registered with water level 1 m too low! One rating (A), two segments (0-4m/4-8m).
These measurements are found qualified for the whole period with water level, oct 1964 – sep 1983.

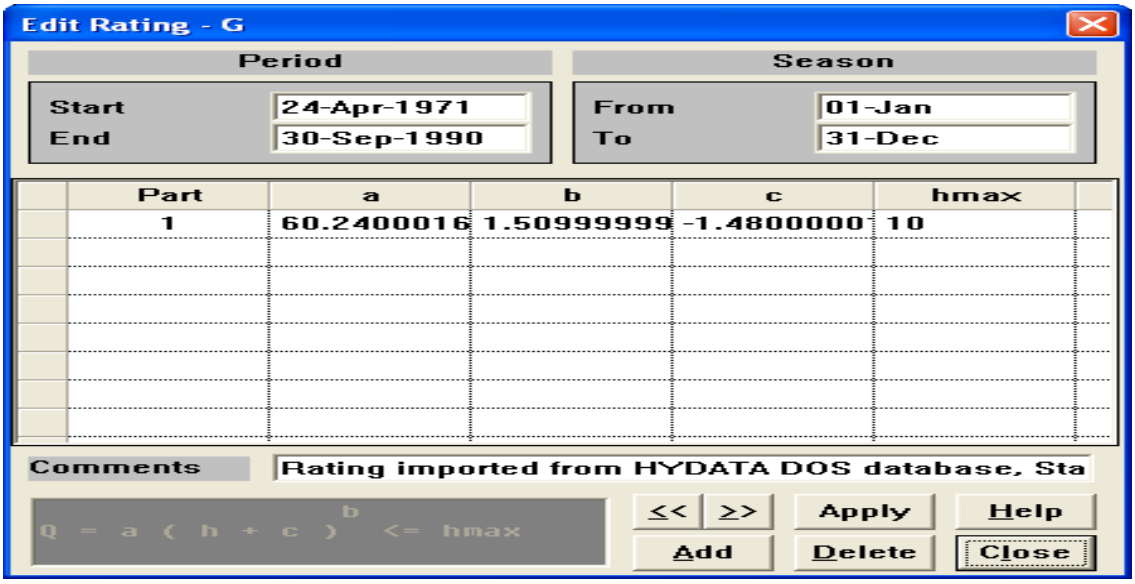


430501, old rating. Periods A, E, F and G. F-period seems dubious. And to get rating oct65-sep67 we need two more rating periods.

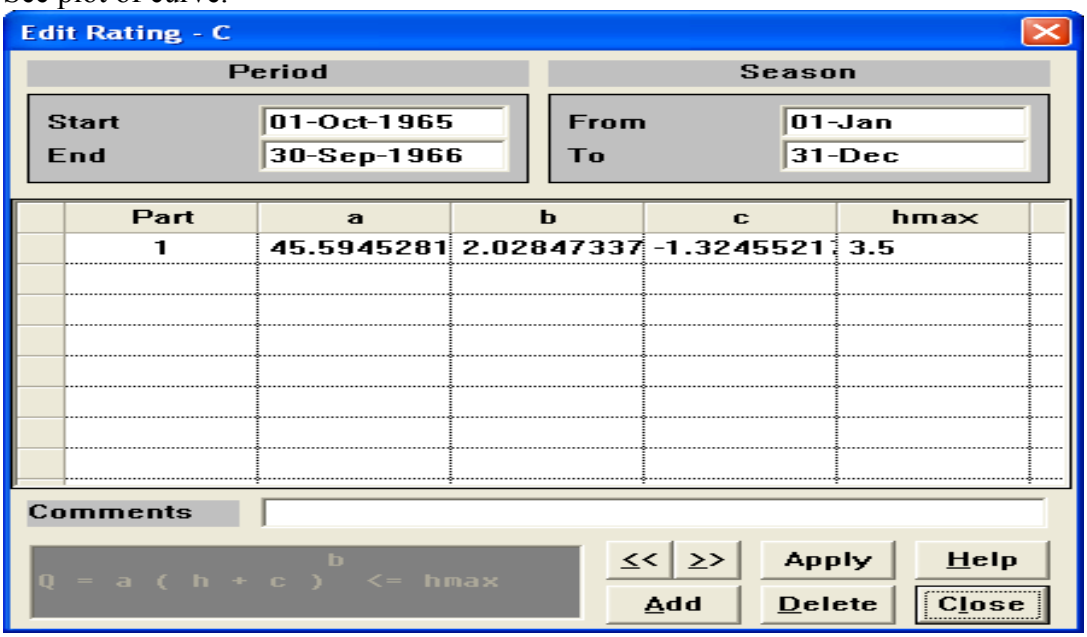


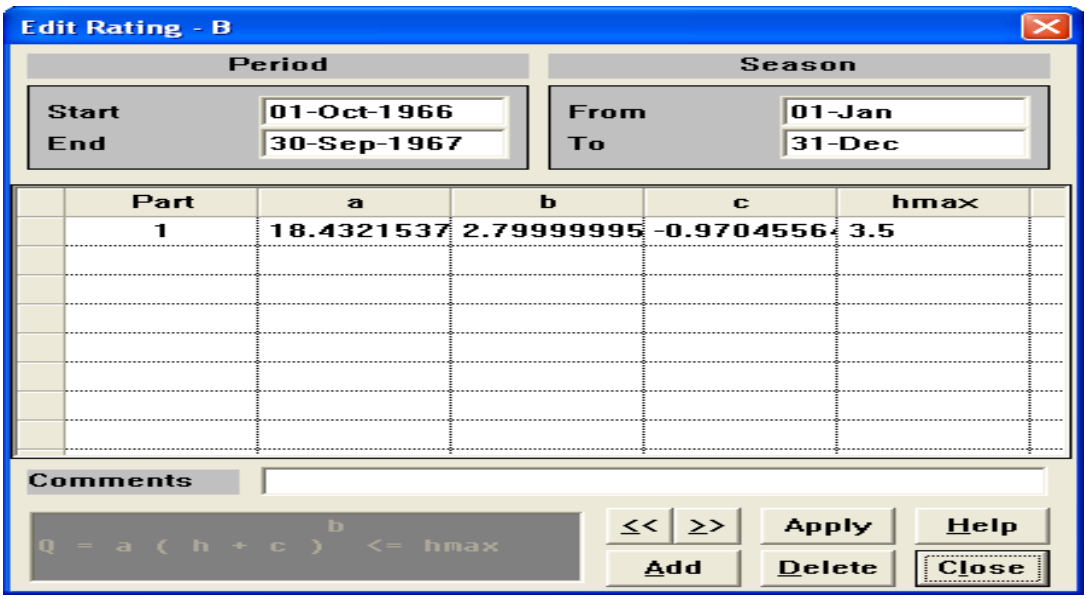


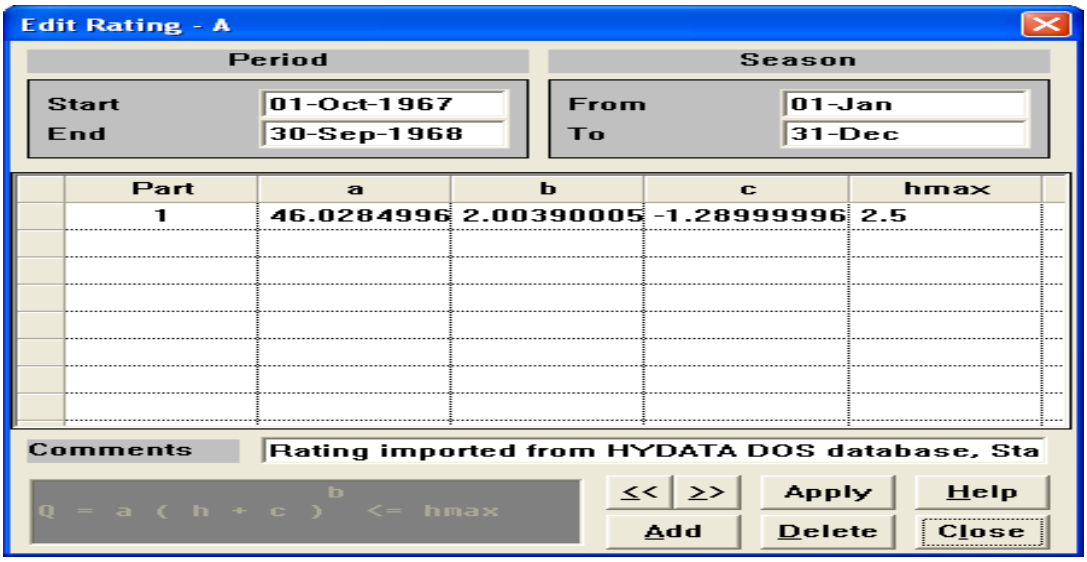

Edit Rating - F
Period
Start
01-Oct-1969
End
23-Apr-1971
Season
From
01-Jan
To
31-Dec
Part
a
b
c
hmax
1
47.7299995
1.91999995
-1.3200000
10
Comments
Rating imported from HYDATA DOS database, Sta
Q = a (h + c)^b <= hmax
<<
>>
Apply
Help
Add
Delete
Close


Edit Rating - G
Period
Start
24-Apr-1971
End
30-Sep-1990
Season
From
01-Jan
To
31-Dec
Part
a
b
c
hmax
1
60.2400016
1.50999999
-1.4800000
10
Comments
Rating imported from HYDATA DOS database, Sta
Q = a (h + c)^b <= hmax
<<
>>
Apply
Help
Add
Delete
Close

430501, new rating. Periods **C, B**, A, E, F and G. F-period seems dubious, but is not found necessary to adjust. Arnt made rating oct65-sep67 which was missing.
See plot of curve.



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01-Oct-1967
End
30-Sep-1968
Season
From
01-Jan
To
31-Dec
Part
a
b
c
hmax
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46.0284996
2.00390005
-1.28999996
2.5
Comments
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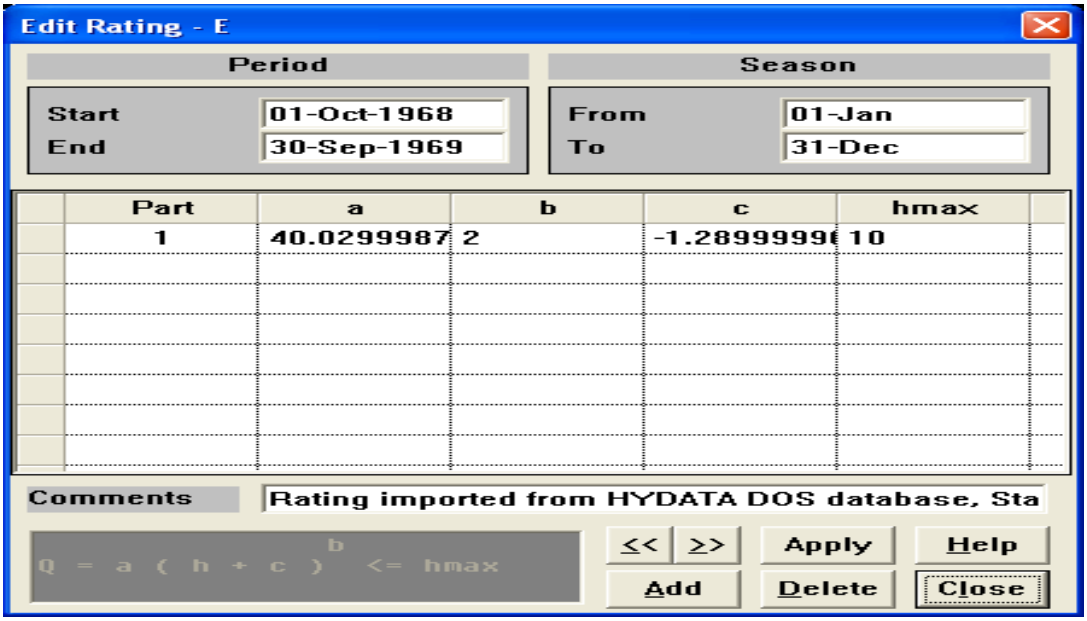
>>
Apply
Help
Add
Delete
Close


Edit Rating - E
Period
Start
01-Oct-1968
End
30-Sep-1969
Season
From
01-Jan
To
31-Dec
Part
a
b
c
hmax
1
40.0299987
2
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Comments
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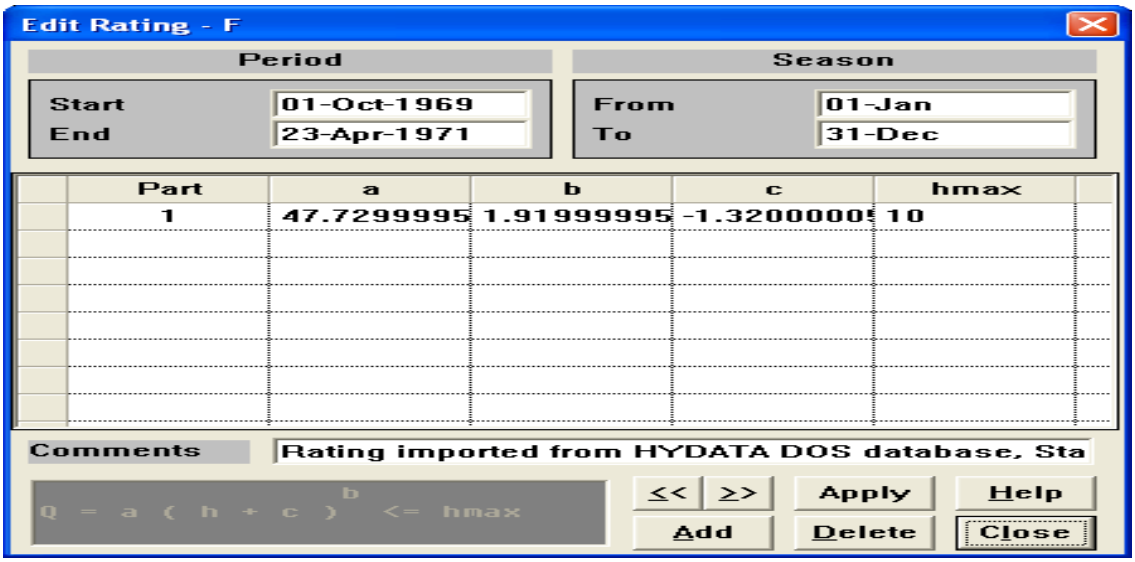
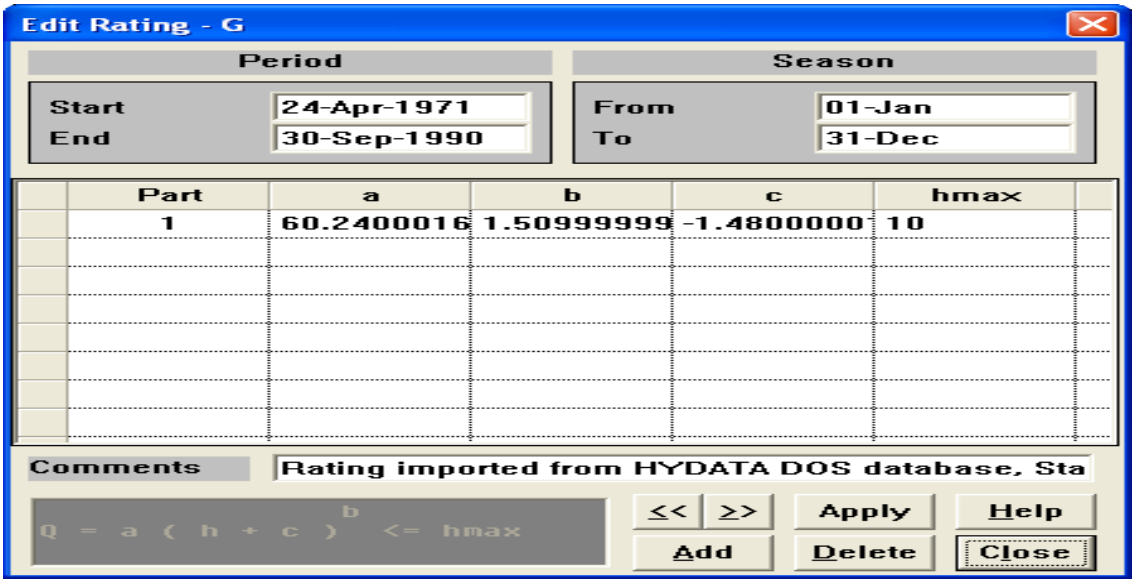
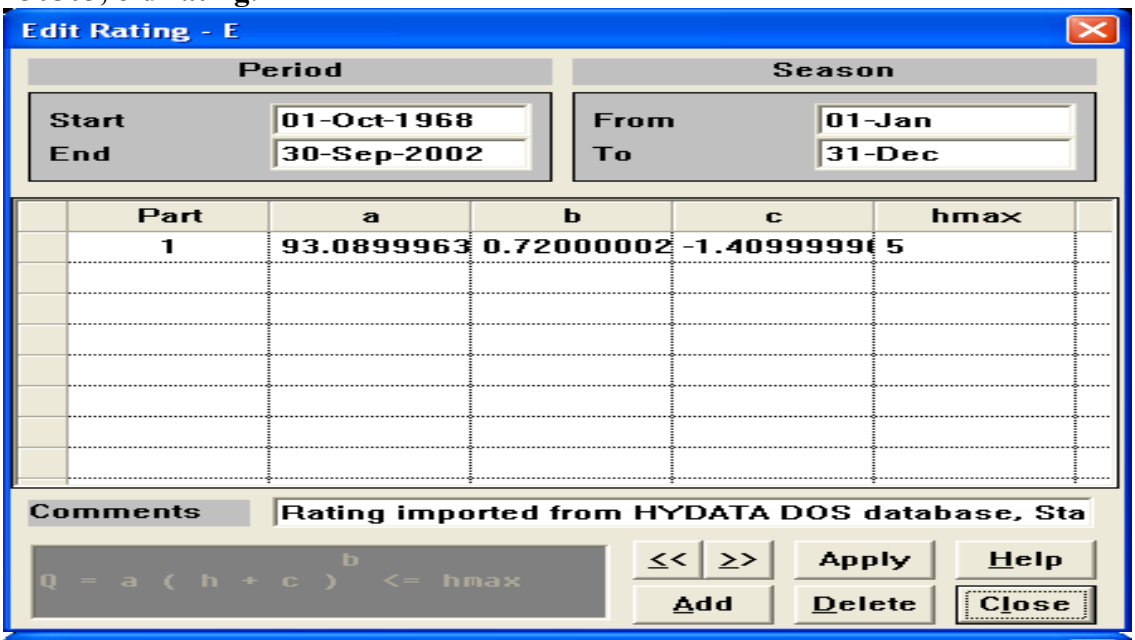
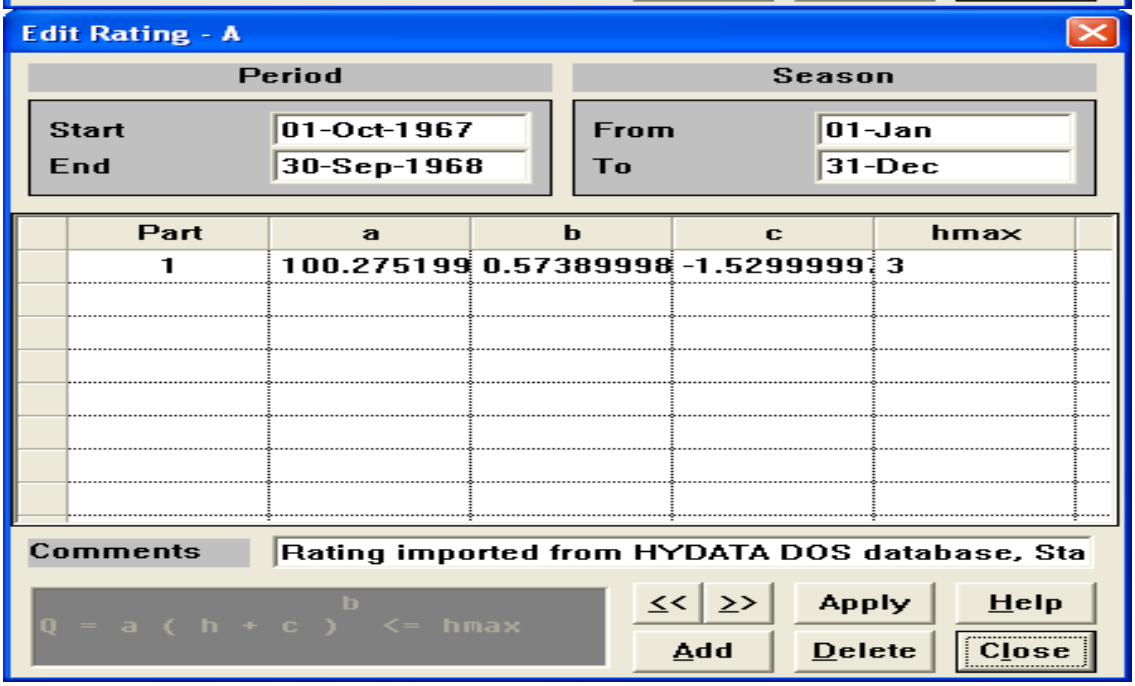
>>
Apply
Help
Add
Delete
Close


Edit Rating - F
Period
Start
01-Oct-1969
End
23-Apr-1971
Season
From
01-Jan
To
31-Dec
Part
a
b
c
hmax
1
47.7299995
1.91999995
-1.3200000
10
Comments
Rating imported from HYDATA DOS database, Sta
Q = a (h + c)^b <= hmax
<<
>>
Apply
Help
Add
Delete
Close

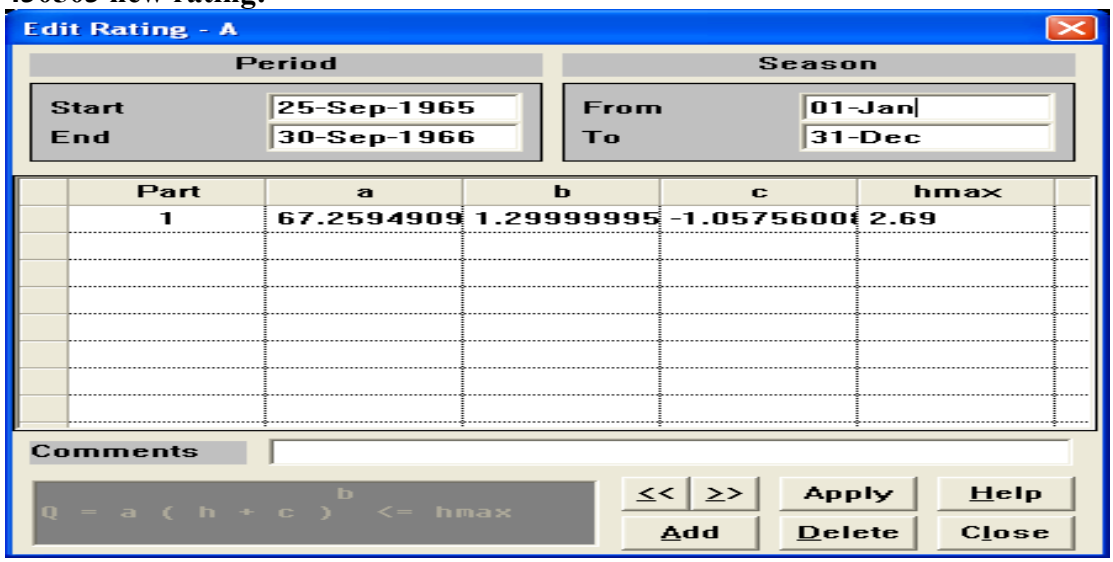

Edit Rating - G
Period
Start
24-Apr-1971
End
30-Sep-1990
Season
From
01-Jan
To
31-Dec
Part
a
b
c
hmax
1
60.2400016
1.50999999
-1.4800000
10
Comments
Rating imported from HYDATA DOS database, Sta
Q = a (h + c)^b <= hmax
<<
>>
Apply
Help
Add
Delete
Close

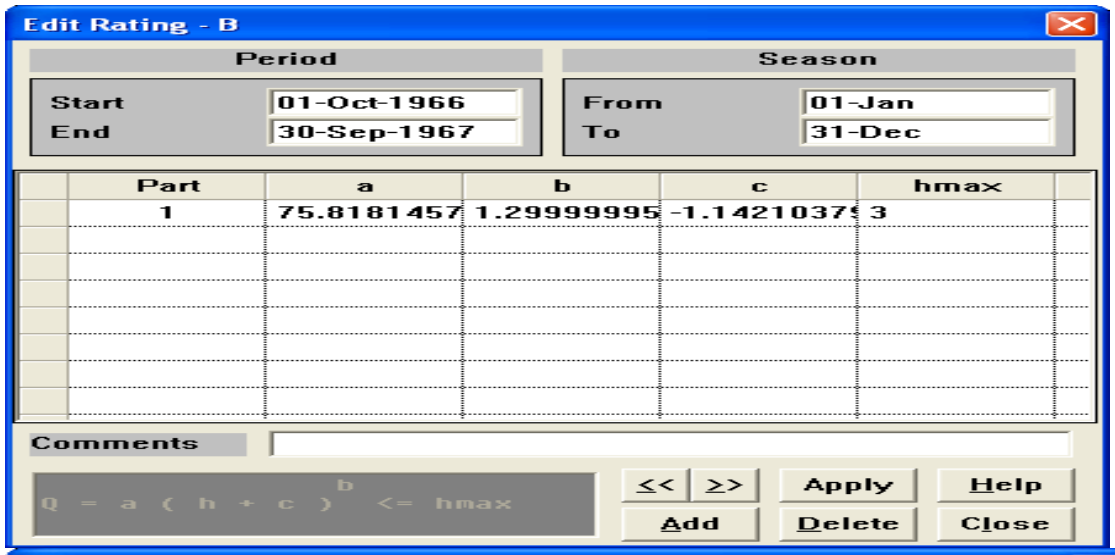
430503, old rating:

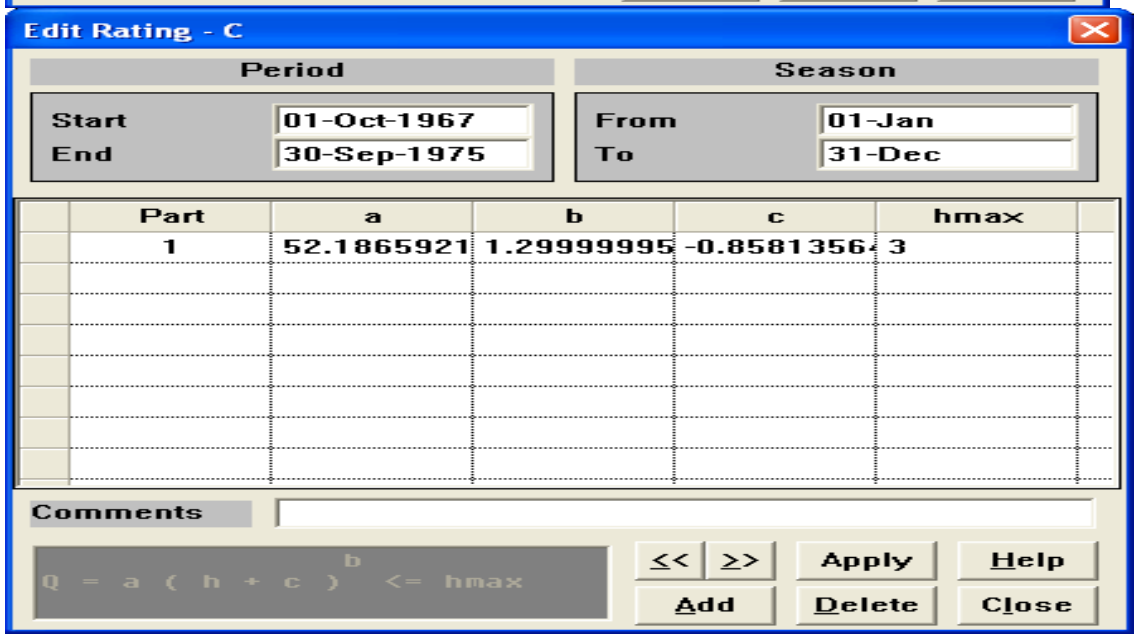




430503 new rating:

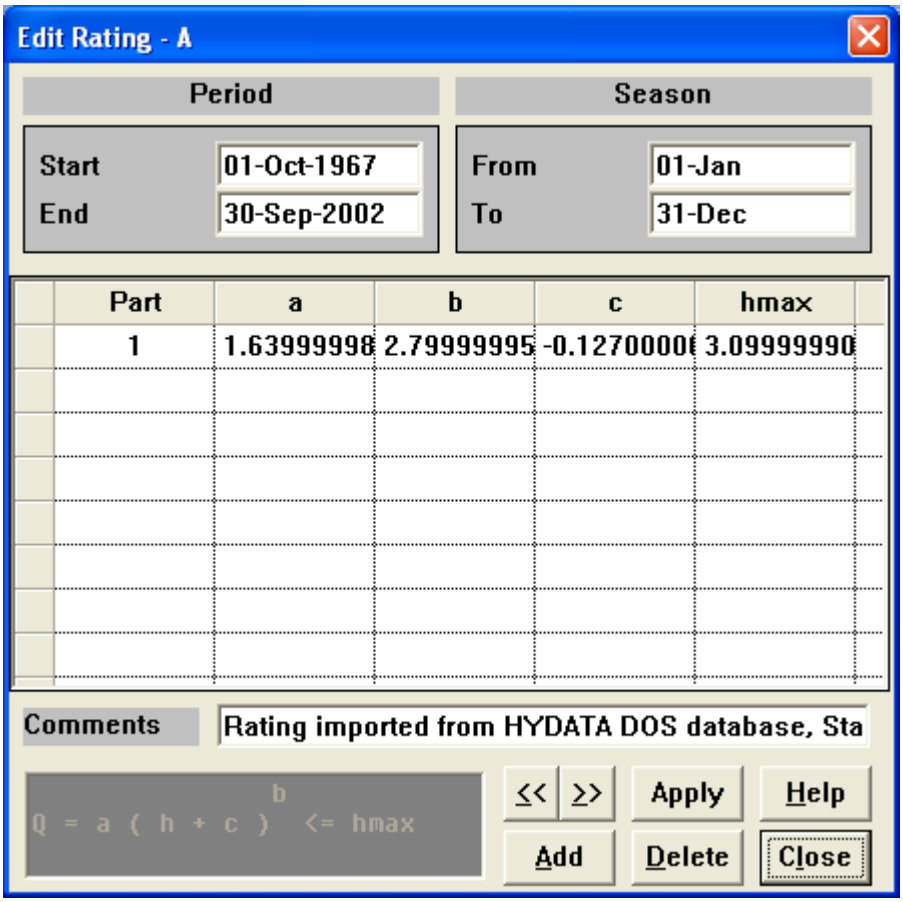






601101 M´BRIDGE – LOA – FAZENDA LOA
RATING.

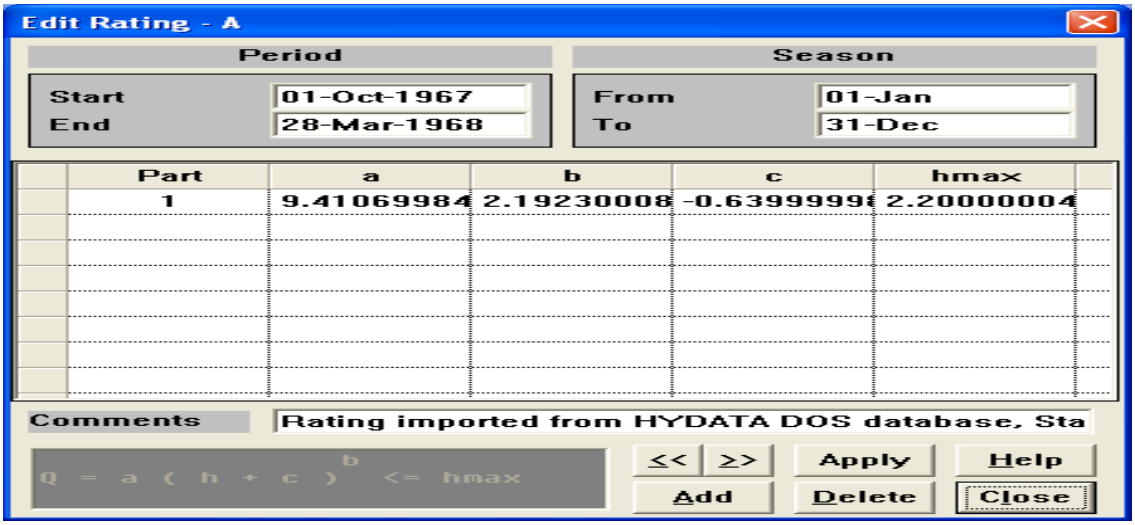
NO MEASUREMENTS IN DATABASE, AND ONLY 6 IN RED BOOK.

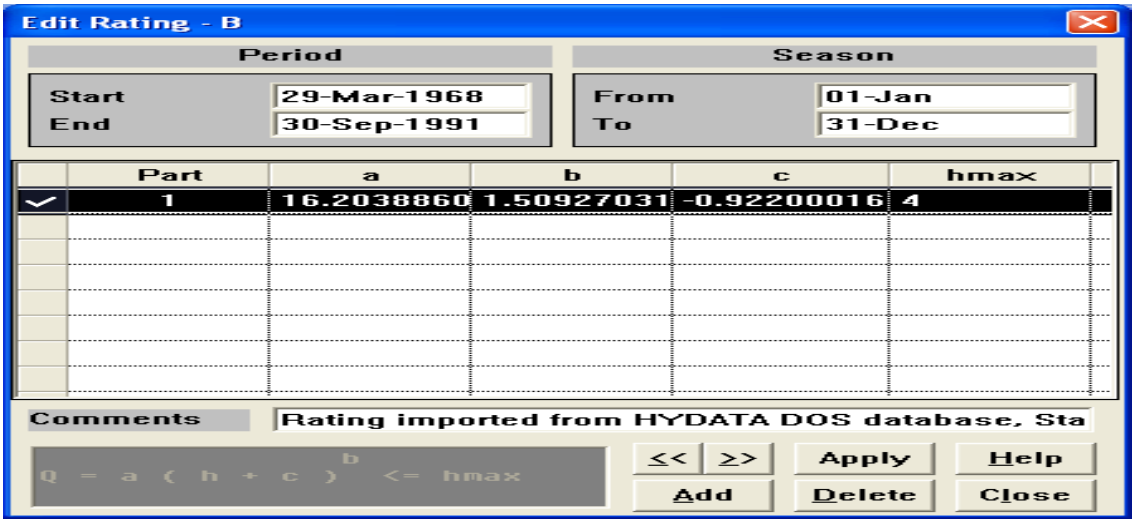


601301 LOGE – LUQUIXE – BARRAGEM, RATING,

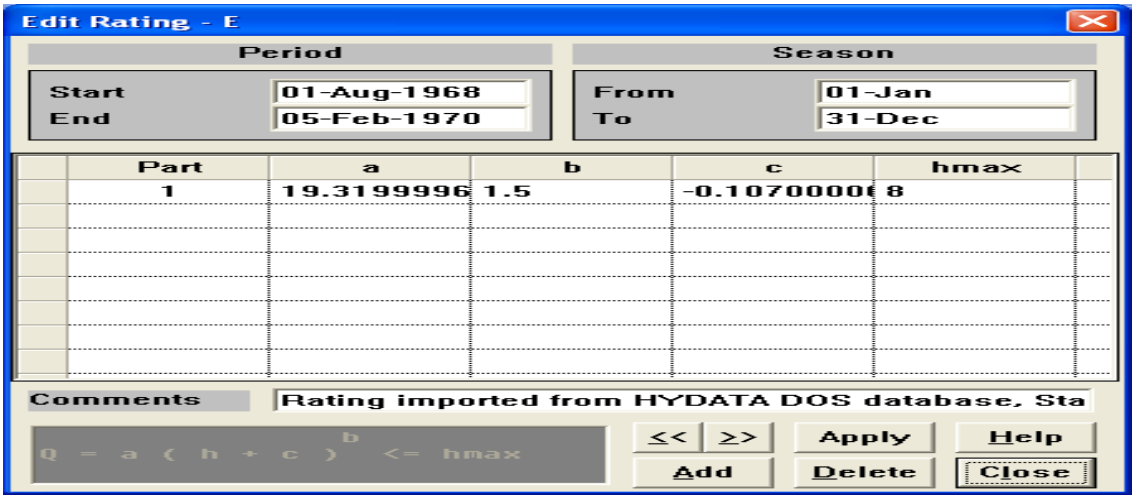
A- BASED ON??

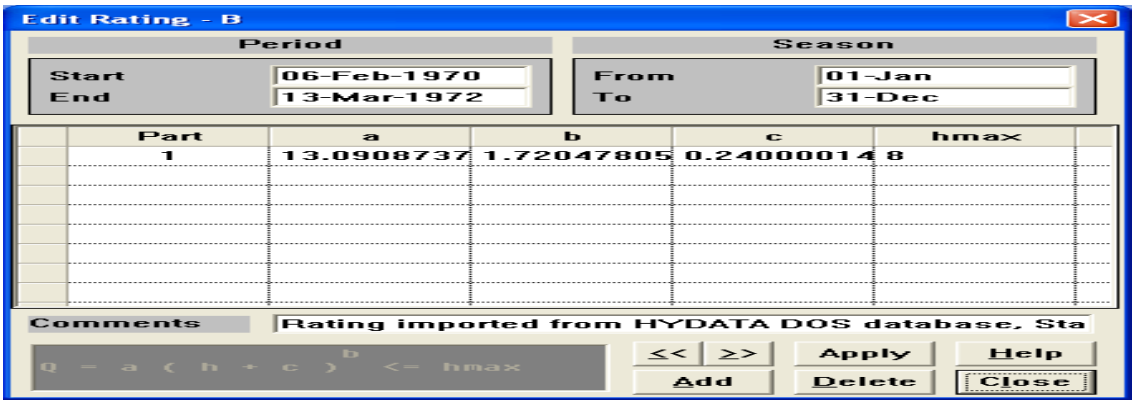
B- B- BASED ON 18 MEASUREMENTS mar68 – aug74

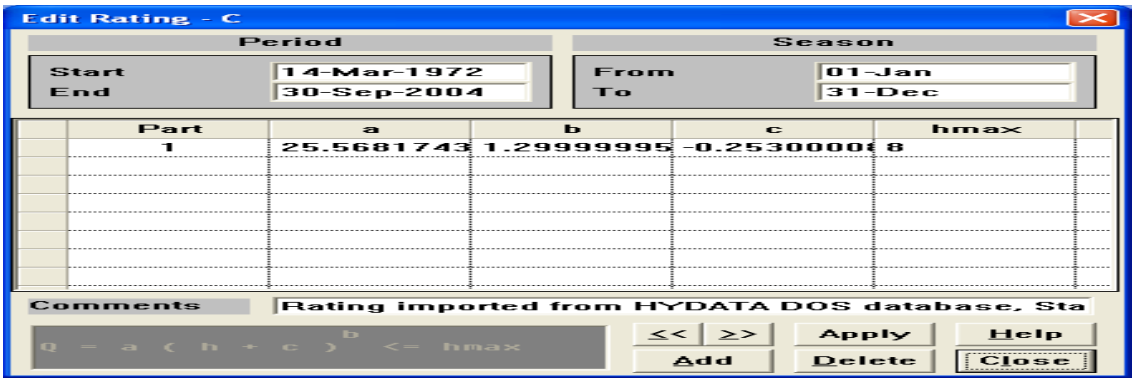




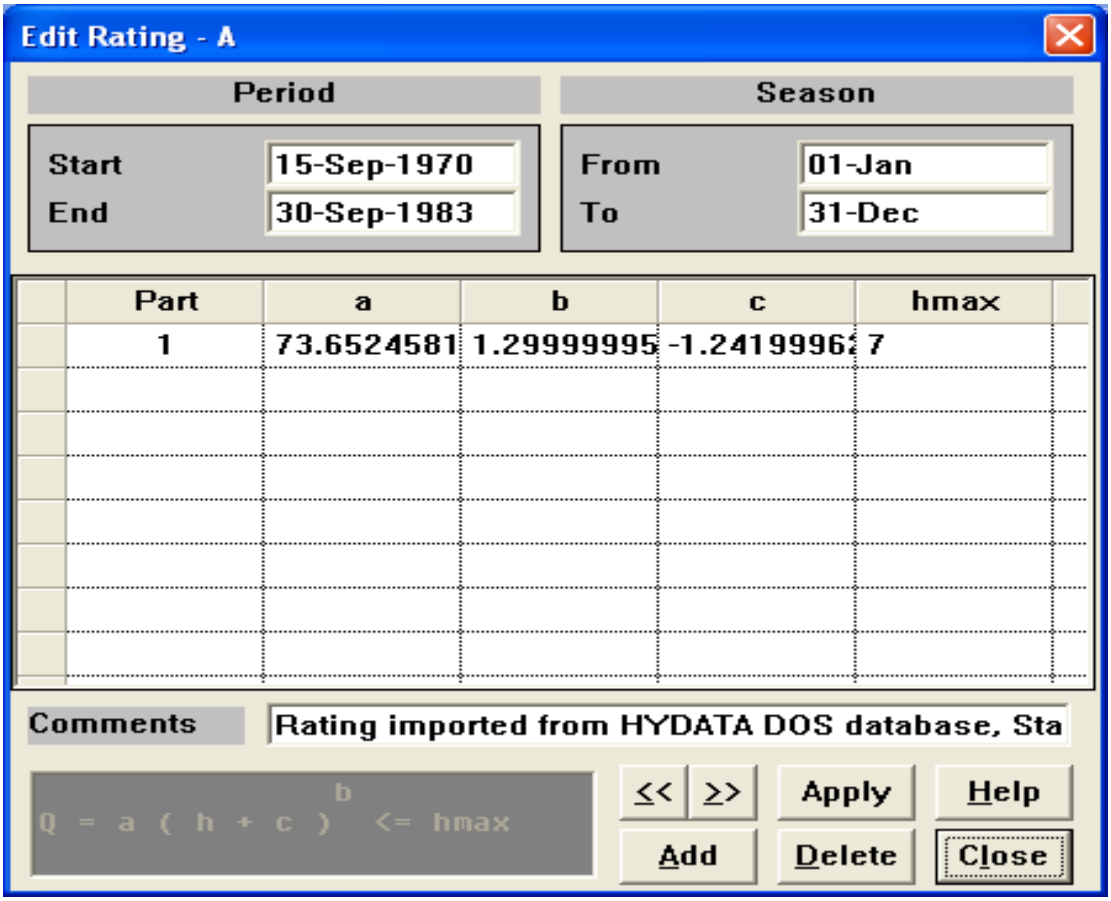
601701 DANDE – PORTO QUIPIRI, RATING
57 MEASUREMENTS OCT 1968 – MAY 1975.
REAL NEED OF 3 PERIODS ? RATING SEEMS OK !!



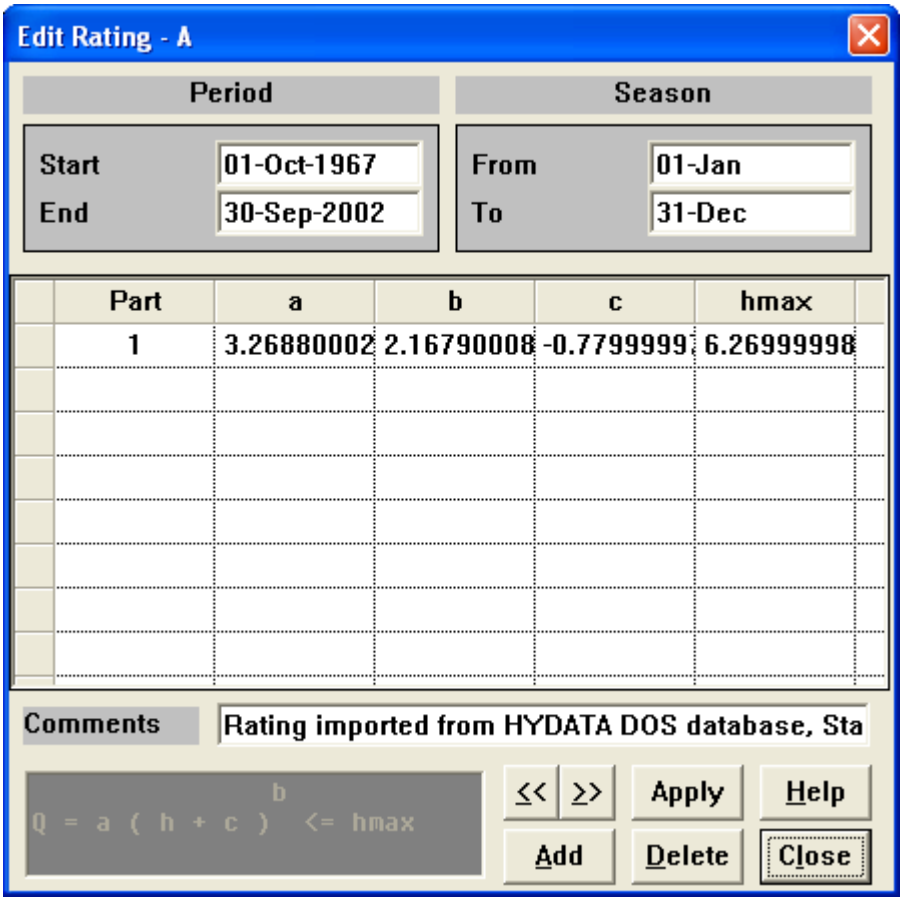




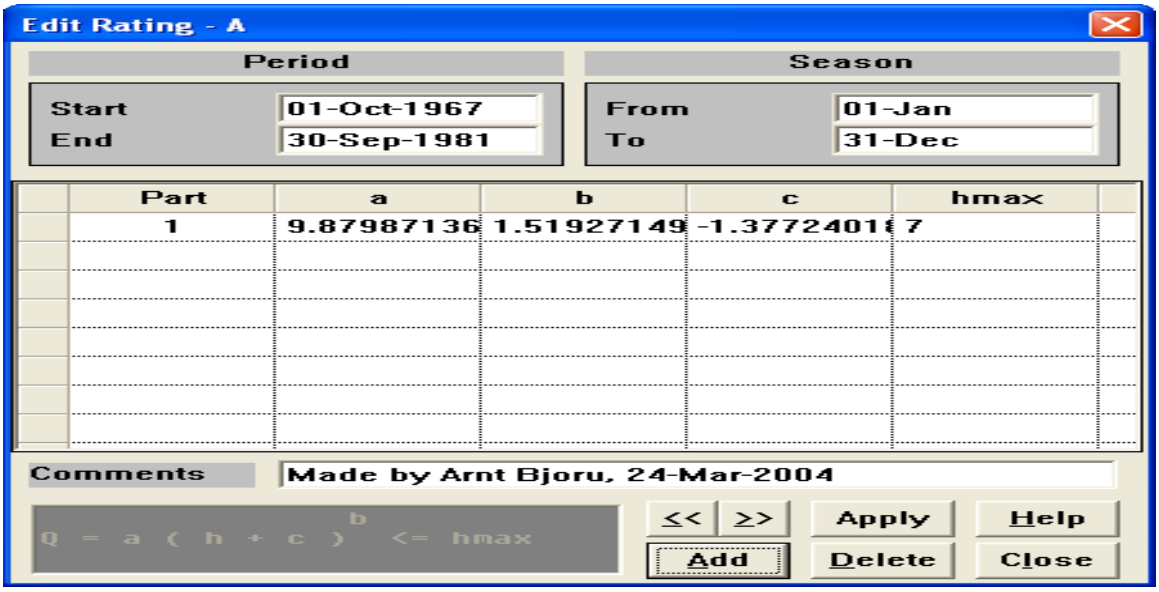
601706 DANDE – PONTE DE QUIBAXE, RATING CURVE
18 MEASUREMENTS BETWEEN 15 – 94 M3/S, 1972 – 1974.
THE RATING SEEMS TO GIVE A LOT TOO MUCH WATER ON HIGH LEVELS.



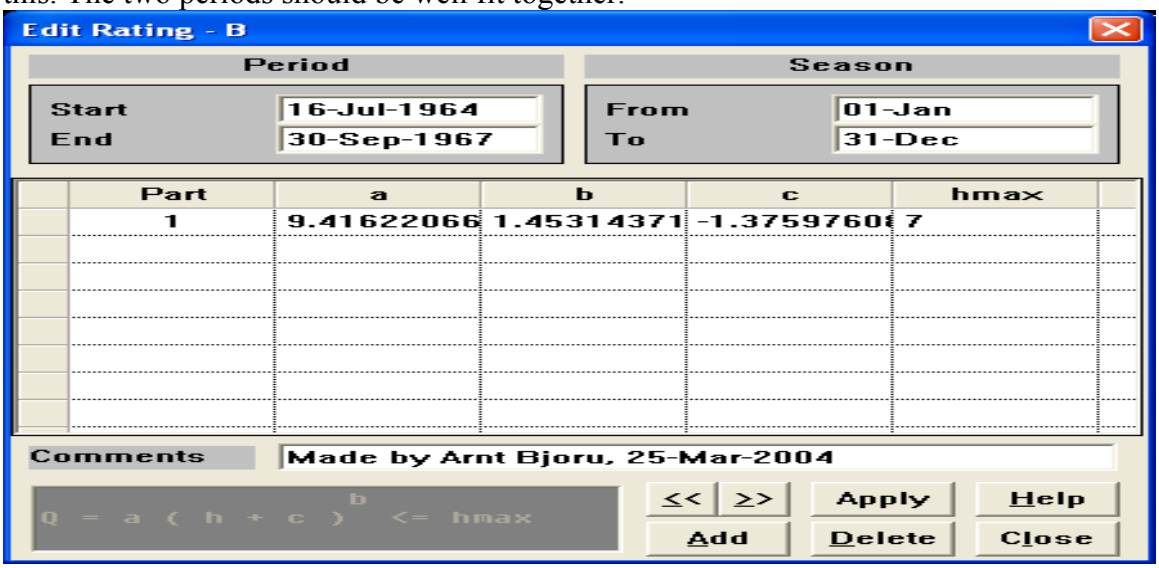
601943 CUANZA-CUNJE-CATABOLA (NOVA SINTRA), old rating based on 101 measurements JAN 1968 – JUL 1975. Some are registered with dubious water level, and the rating do no fit well with 44 of the measurements (> +/- 10 %).



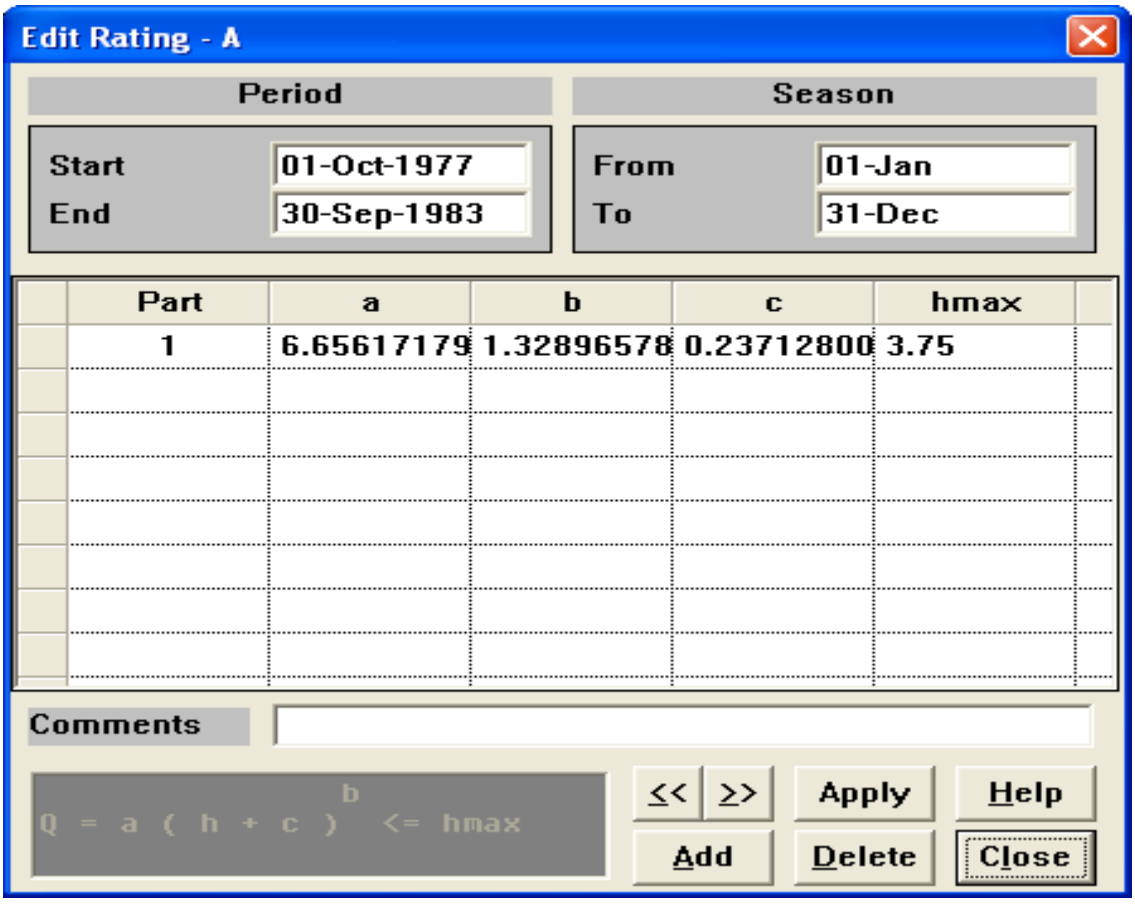
601943 CUANZA-CUNJE-CATABOLA (NOVA SINTRA), new A rating based on 101 measurements JAN 1968 – JUL 1975. Some were registered with dubious water level. The rating do now fit well with all the measurements apart from 16 (> +/- 10 %).



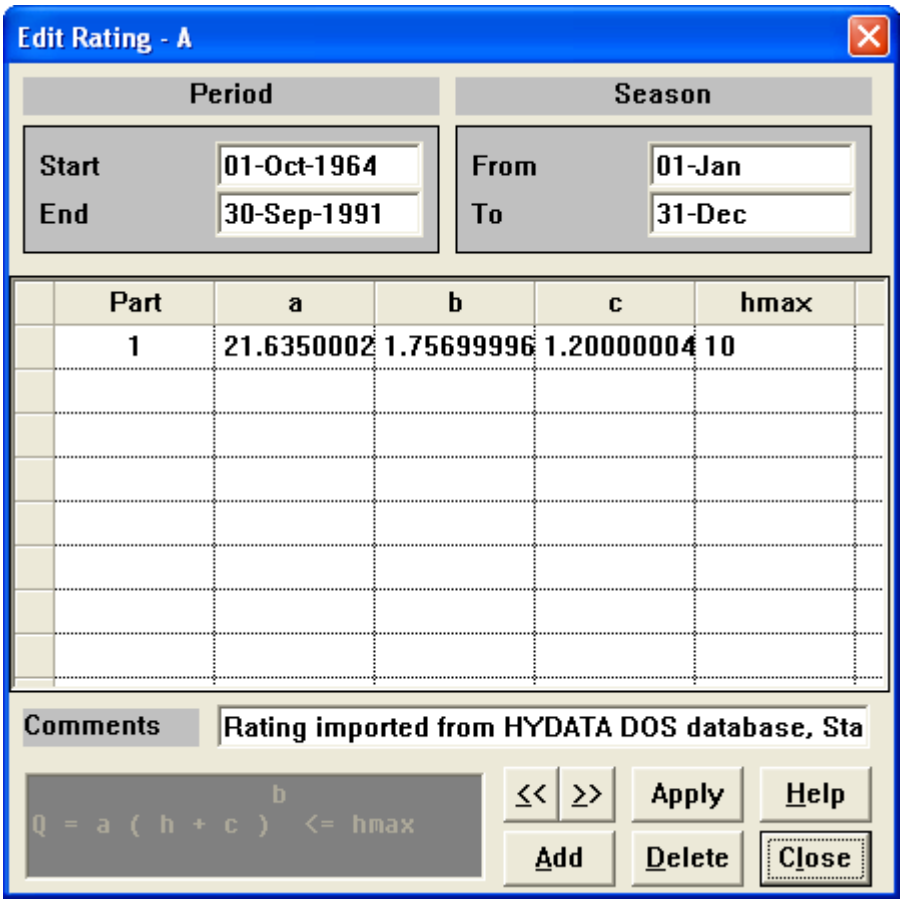
Even more measurements could be introduced, and I did so for jul64-dec67 (90 measurements). And made the following good fit. It seems a periodic change after 1969 flood-event could be considered, but the well fit of both periods made me leave it like this. The two periods should be well fit together.



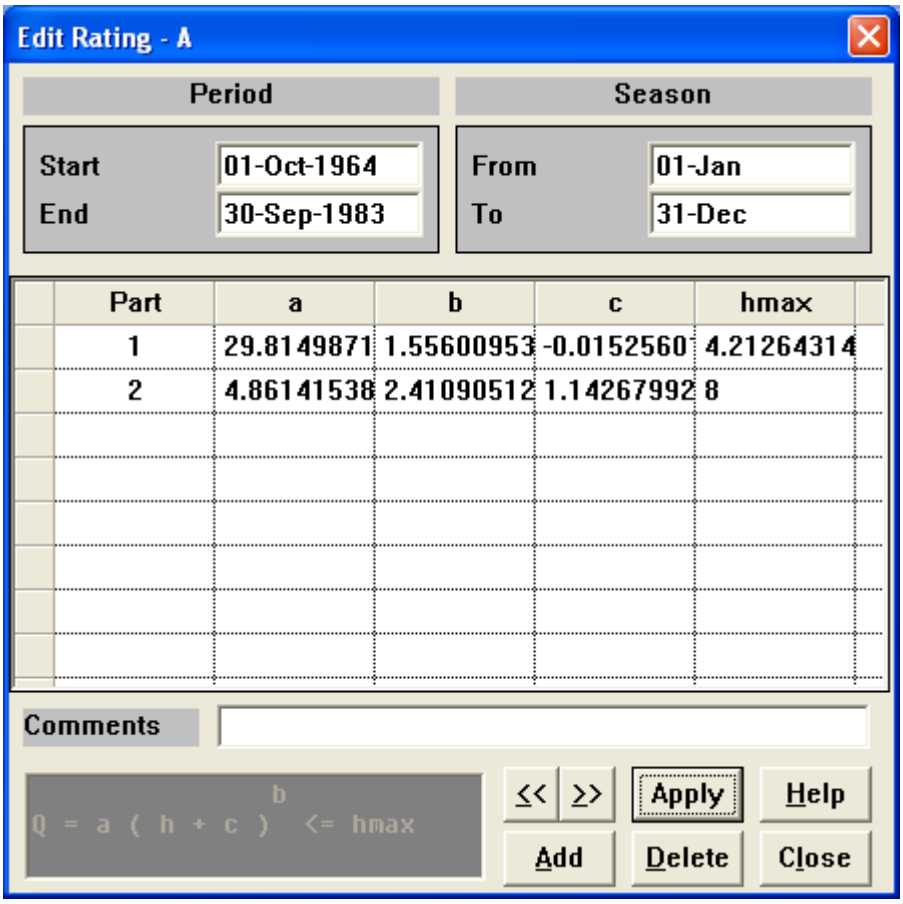
601946 CUANZA-CUIJE-PONTE DO CUIJE. Old rating based on 49 measurements dec 1977 – oct 1983. Some measurements are registered with dubious water level, and the rating does not fit well with 19 of the measurements (> +/- 10 %). I fear that more than one period is needed.



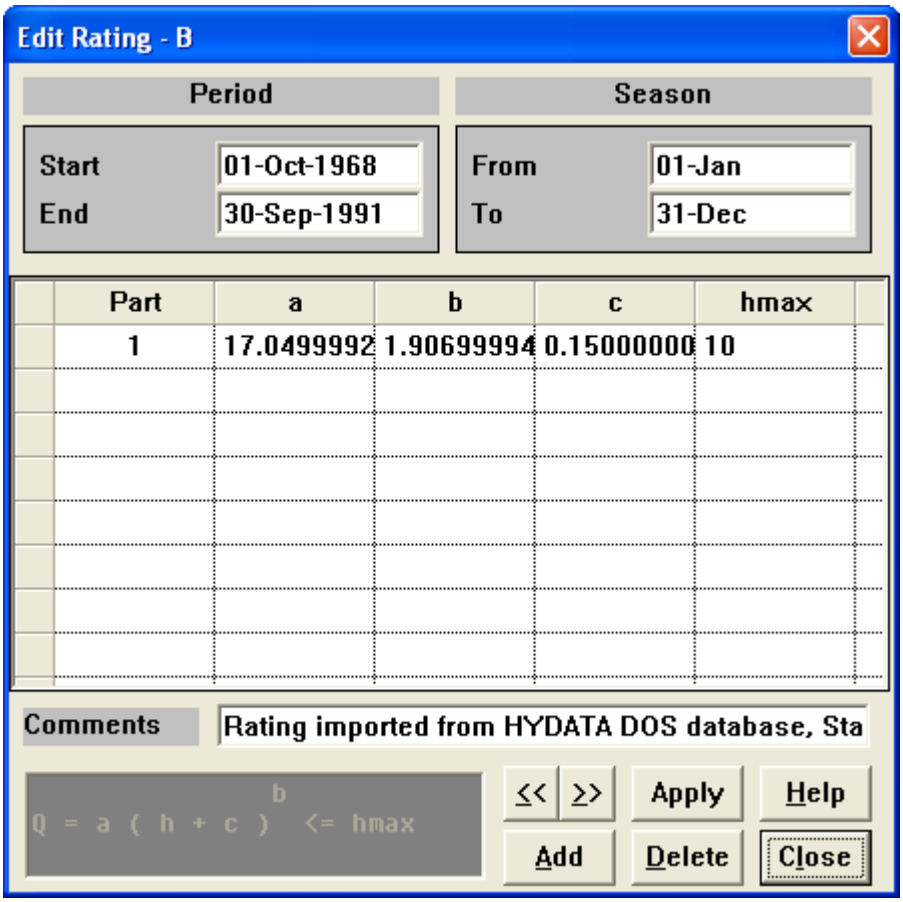
603004 QUEVE – CACHOEIRAS DA BINGA, old rating based on measurements dec 1967 – jun 1974. Most measurements were registered with water level 1 m too low.



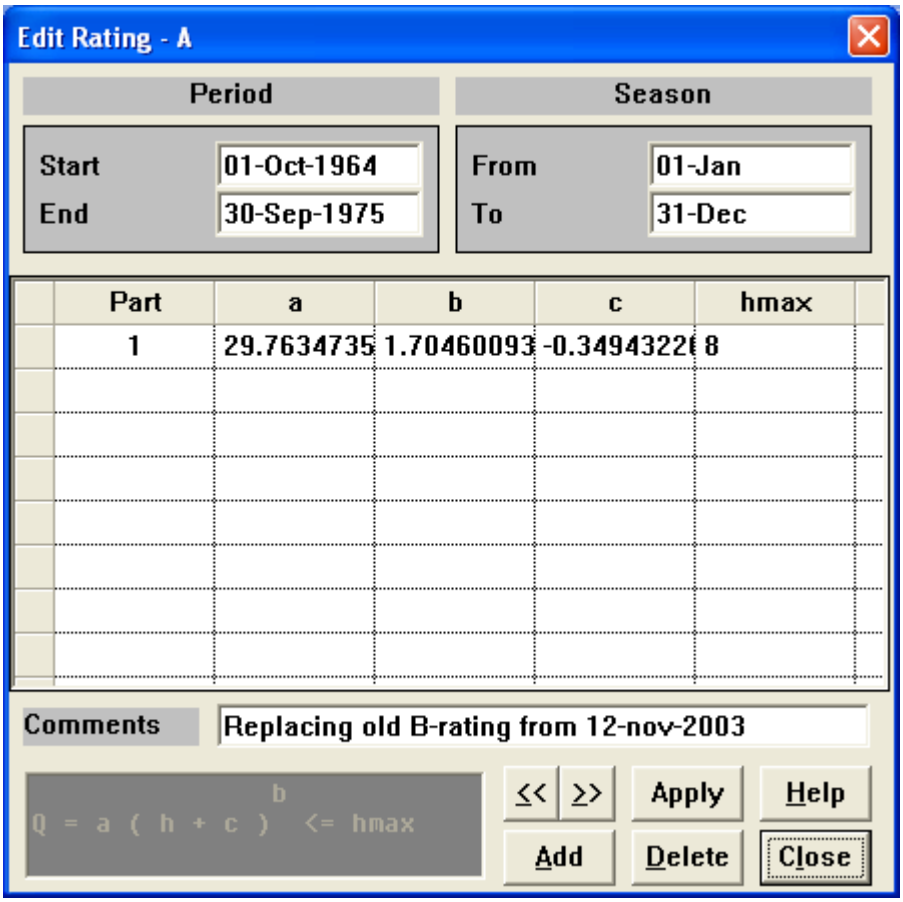
603004 QUEVE – CACHOEIRAS DA BINGA, <u>new</u> rating based on 109 measurements dec 1967 – jun 1974. Measurements and water level corrected.



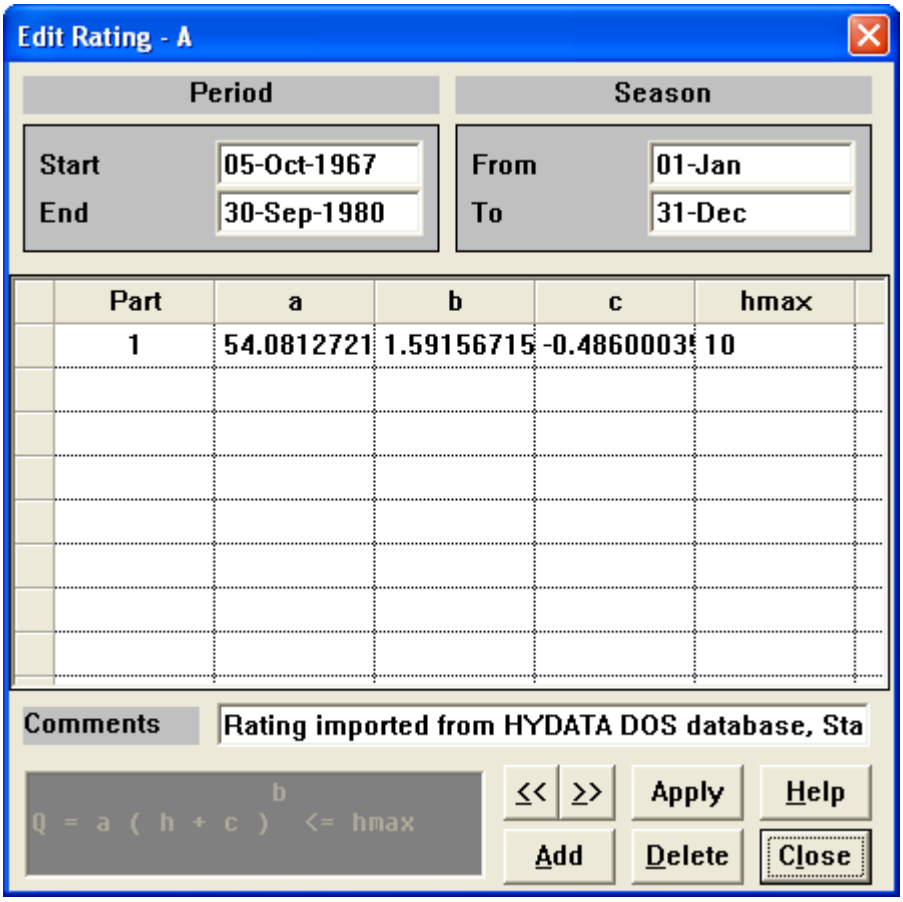
603009 QUEVE –GINGA, old rating based on 86 measurements nov 1968 – jul 1975. Some measurements had registration errors. It seems we can make <u>one</u> new rating from 98 measurements, and qualify it for the whole period oct 1964 – sept 1975.



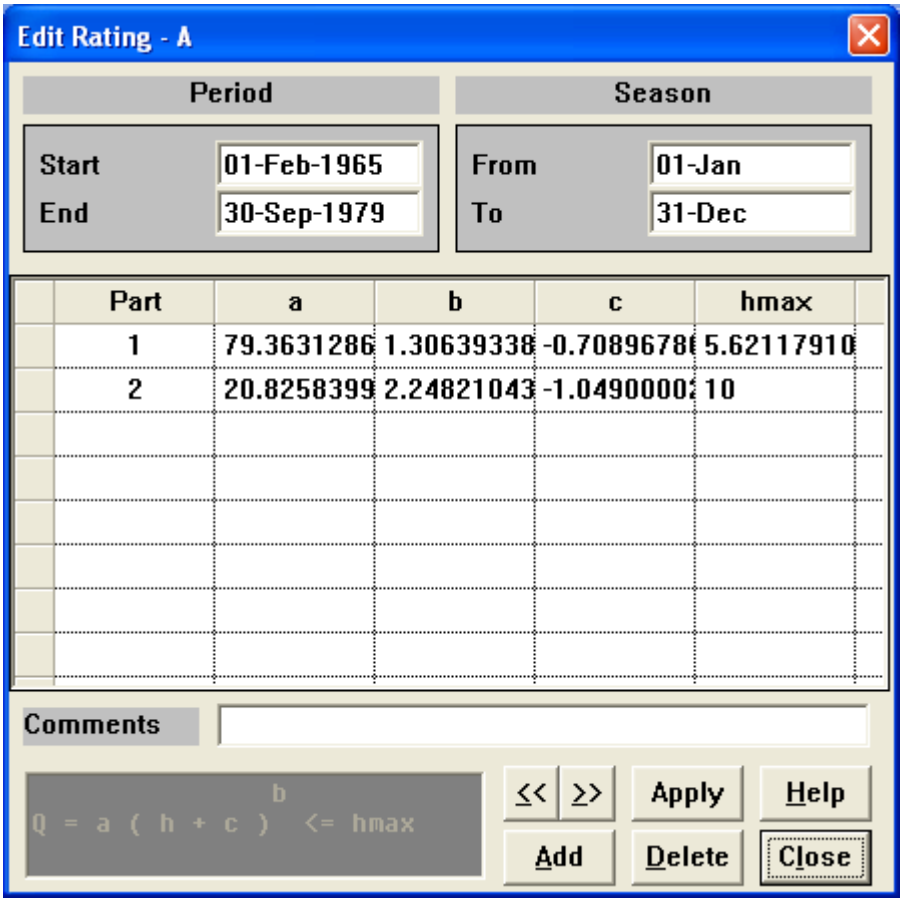
603009 QUEVE –GINGA, new rating based on 98 measurements oct 1966 – jul 1975.
It is made <u>one</u> new rating from 98 measurements, qualified for the whole period oct 1964 – sept 1975.



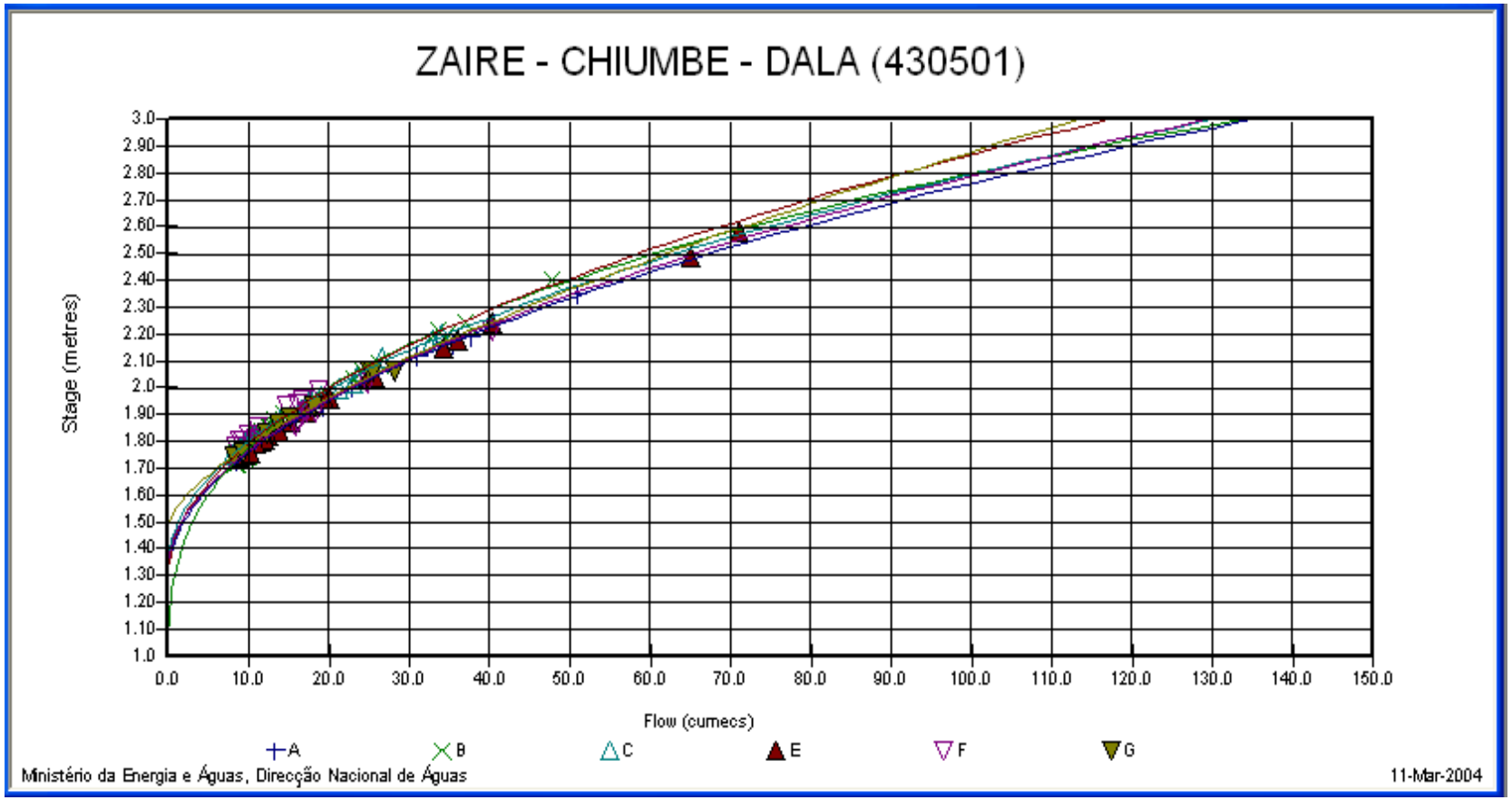
607320 CUNENE – MATUNTO, old rating based on measurements OCT 1967 – JUN 1974. All measurements are not registered in the **Hydata-database (65-67, 74-75, and some in 1973) ! This will be done by Arnt**.



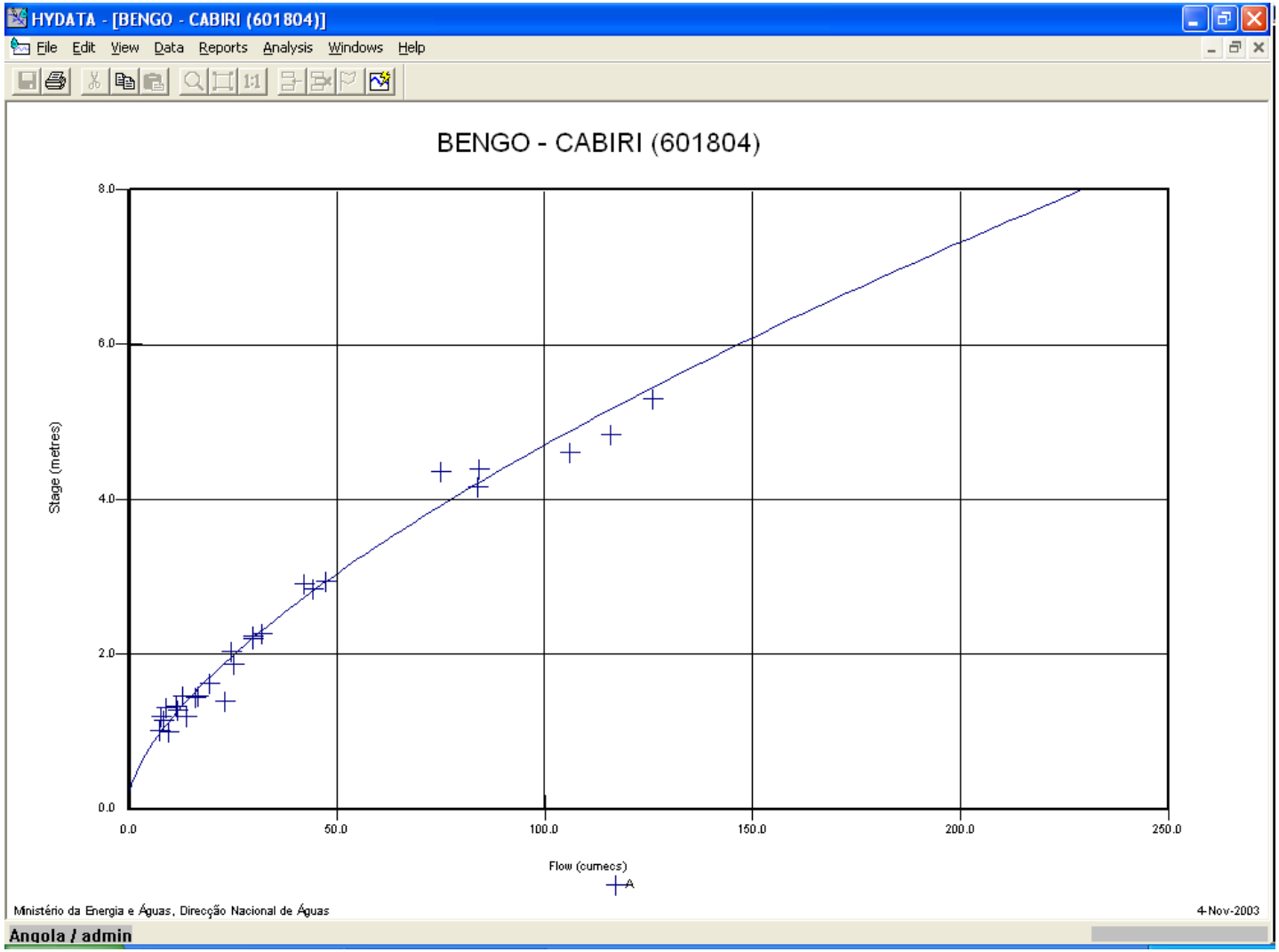
607320 CUNENE – MATUNTO, new rating based on 135 measurements FEB 1965 – JUL 1975.
All measurements are now registered in the **Hydata-database !**



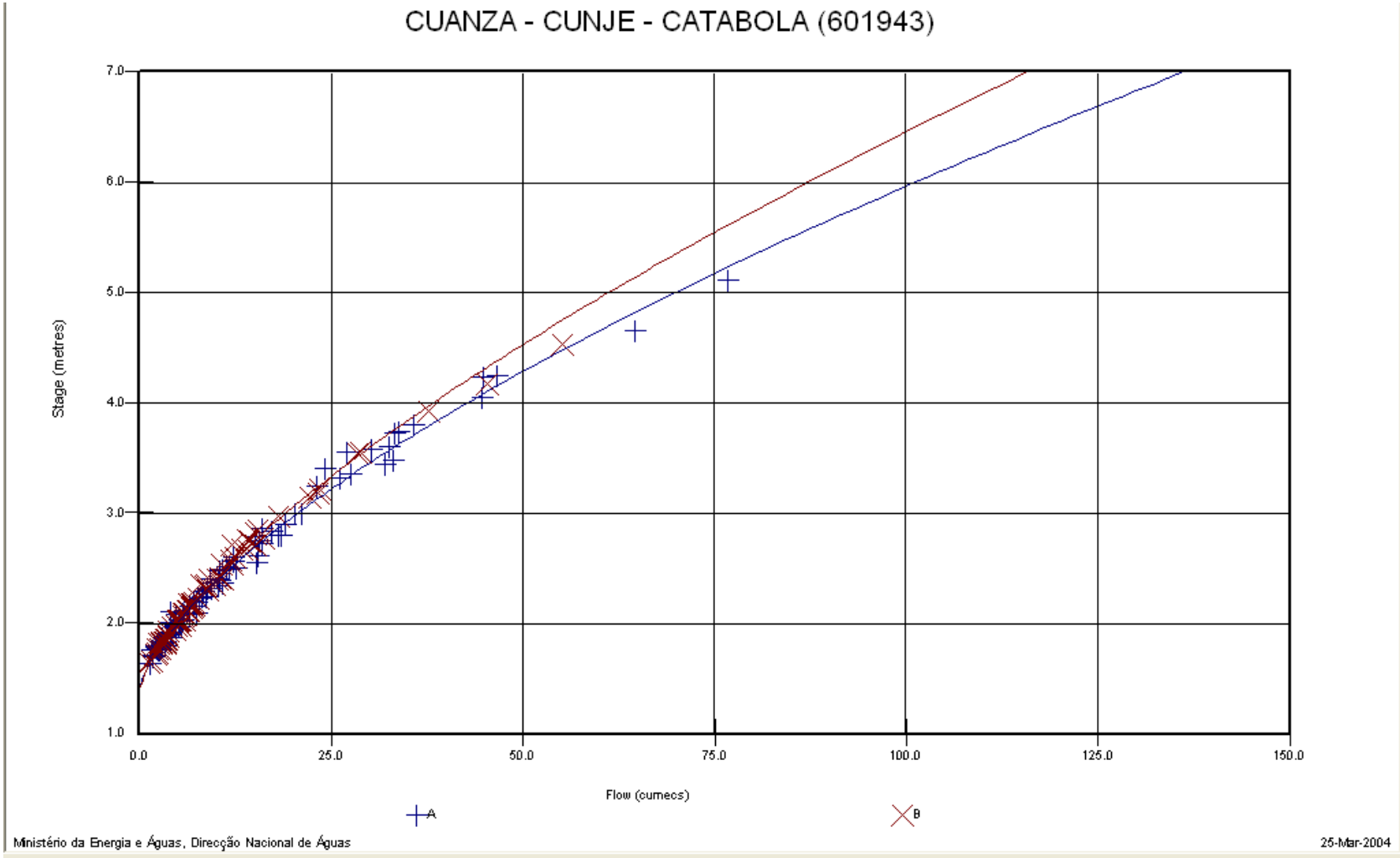
430501 ZAIRE- DALA, rating curves. Chronological periods C, B, A, E, F and G
B and C period made by Arnt. F-period was considered adjusted, but is not adjusted.



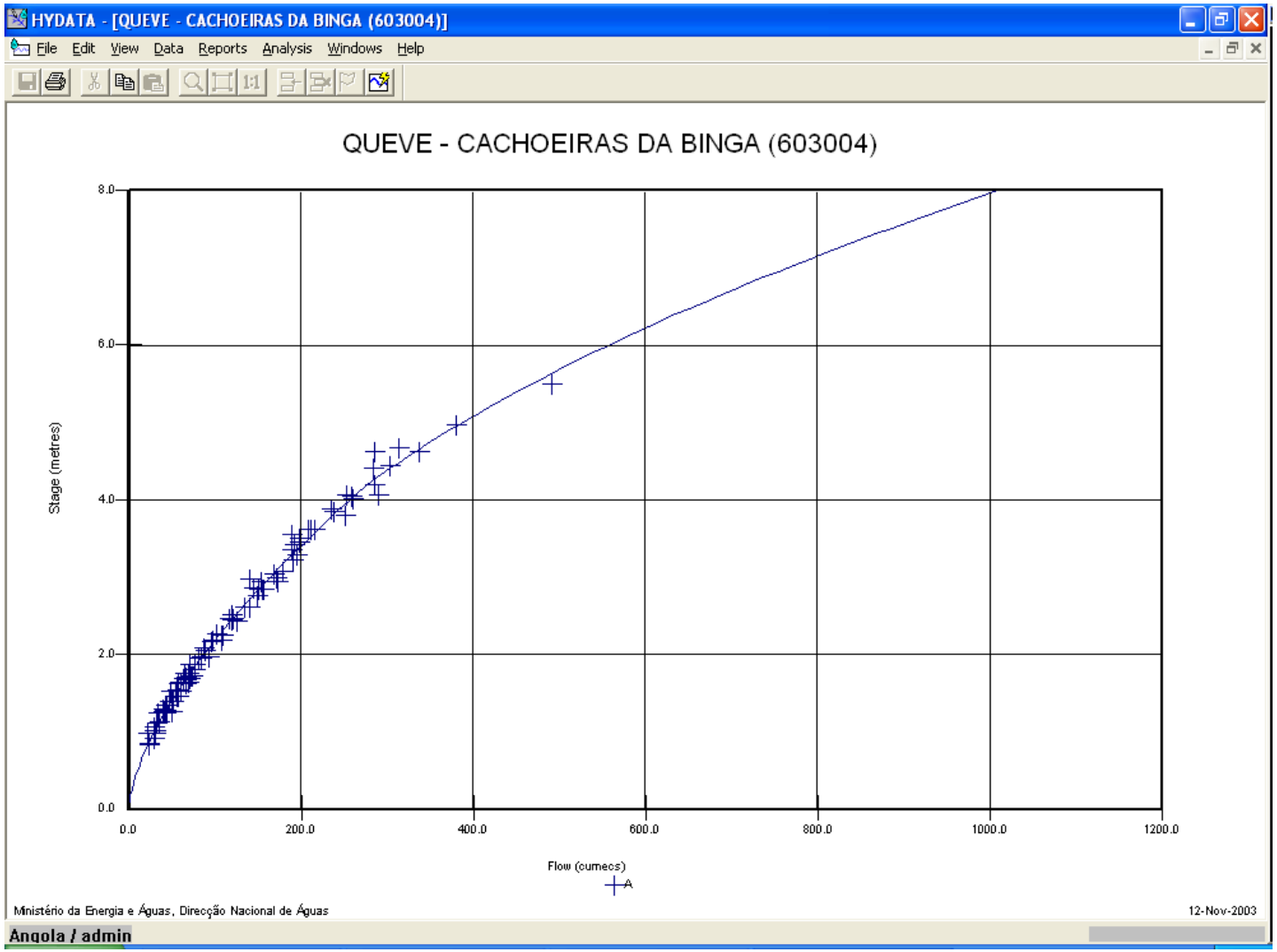
Rating curve 601804, “noisy” but OK?! Not too many measurements in the period **oct 68-oct 80. All measurements registered and used?**



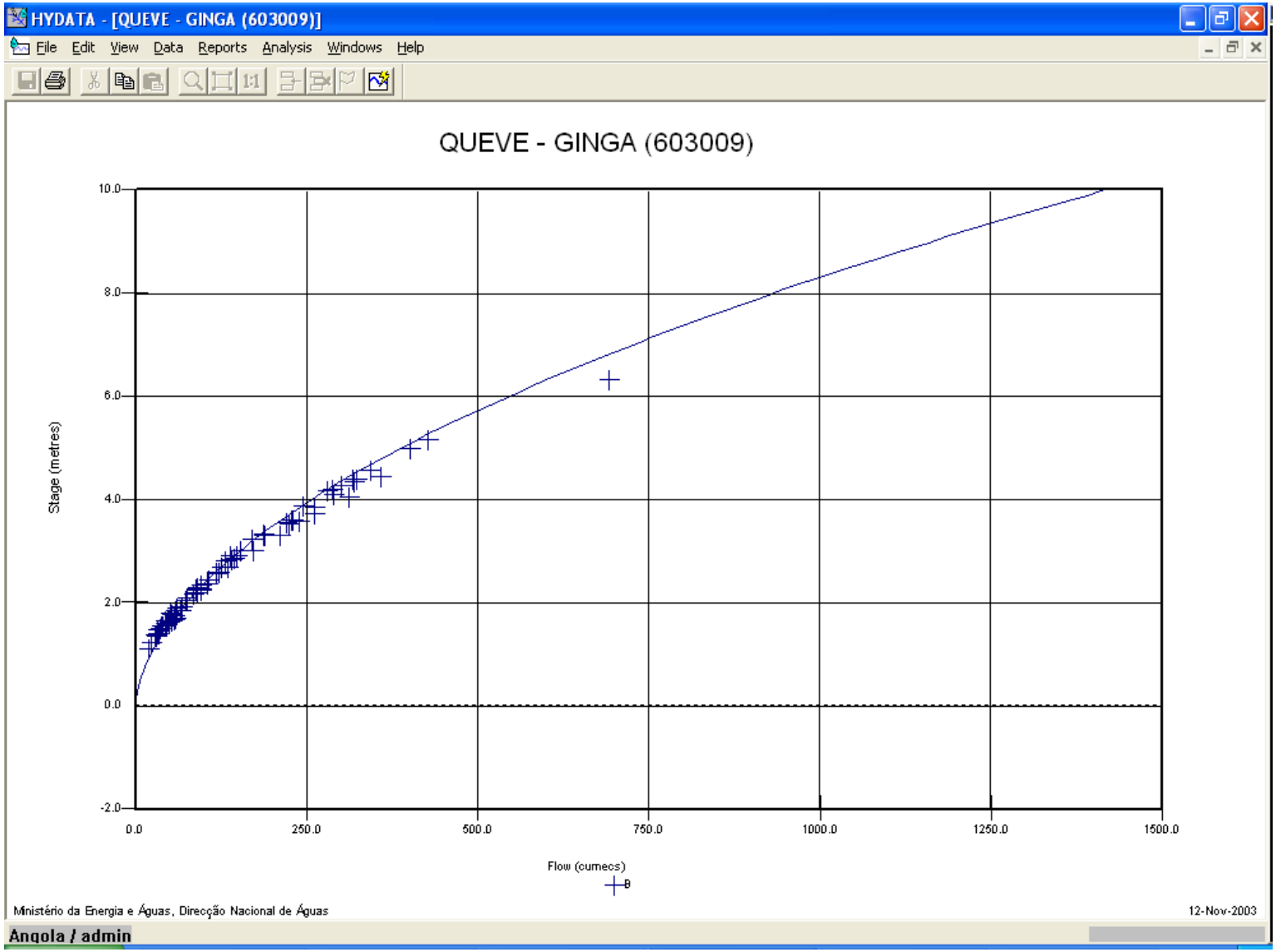
Rating curve 601943, B and A rating made 25-Mar-2004. 192 measurements in the period **jul64-jul75. Could be a candidate for two segments. 91 measurements 64-67 introduced today, and level data oct66-apr67 introduced – by Arnt.**



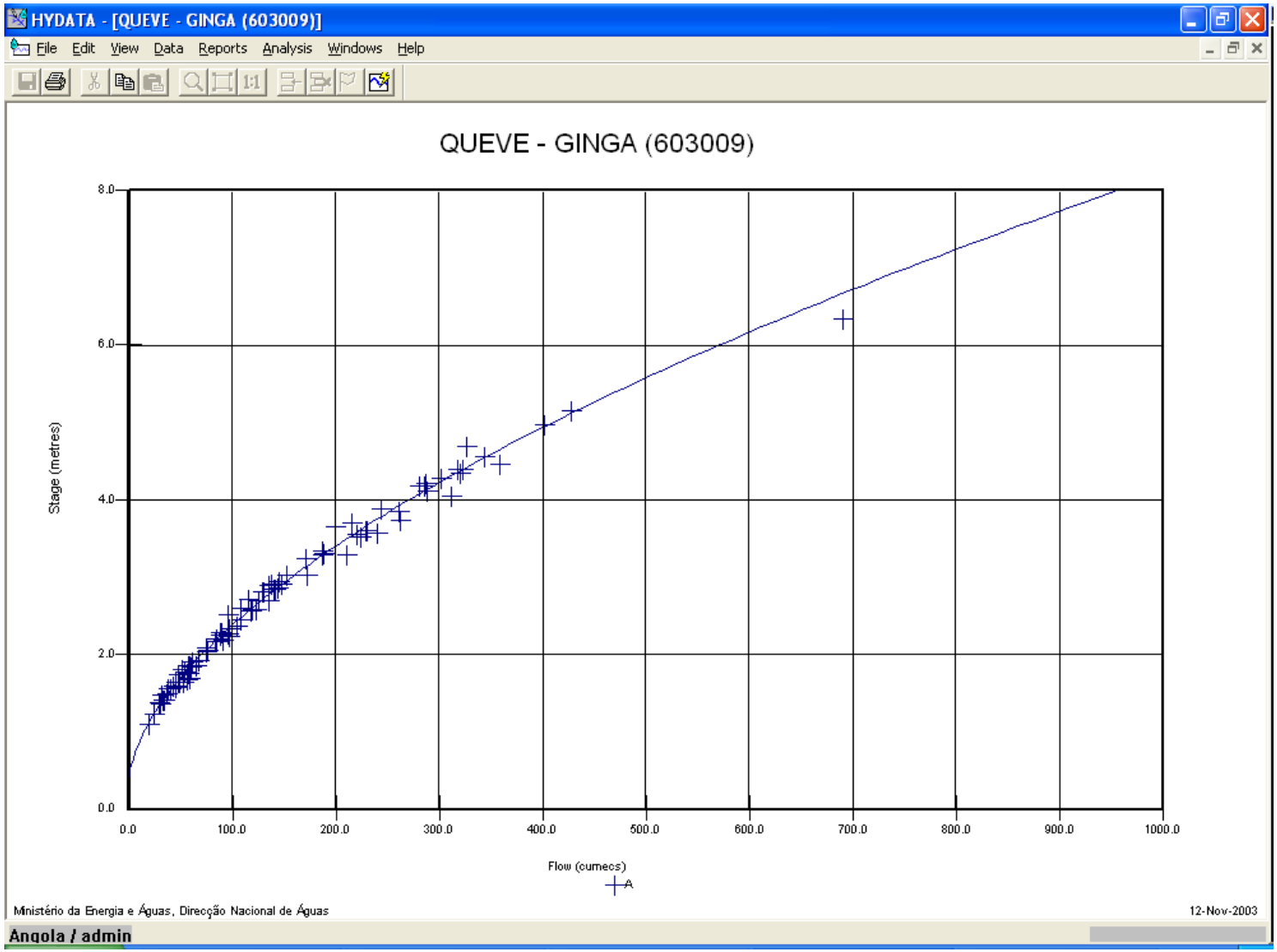
Rating curve 603004, NEW! Based on 109 measurements in the period dec67-jun74. All measurements are registered and used, Most were registered with water level 1 m too low! One rating (A), two segments (0-4m/4-8m).
These measurements are found qualified for the whole period with water level, oct 1964 – sep 1983.



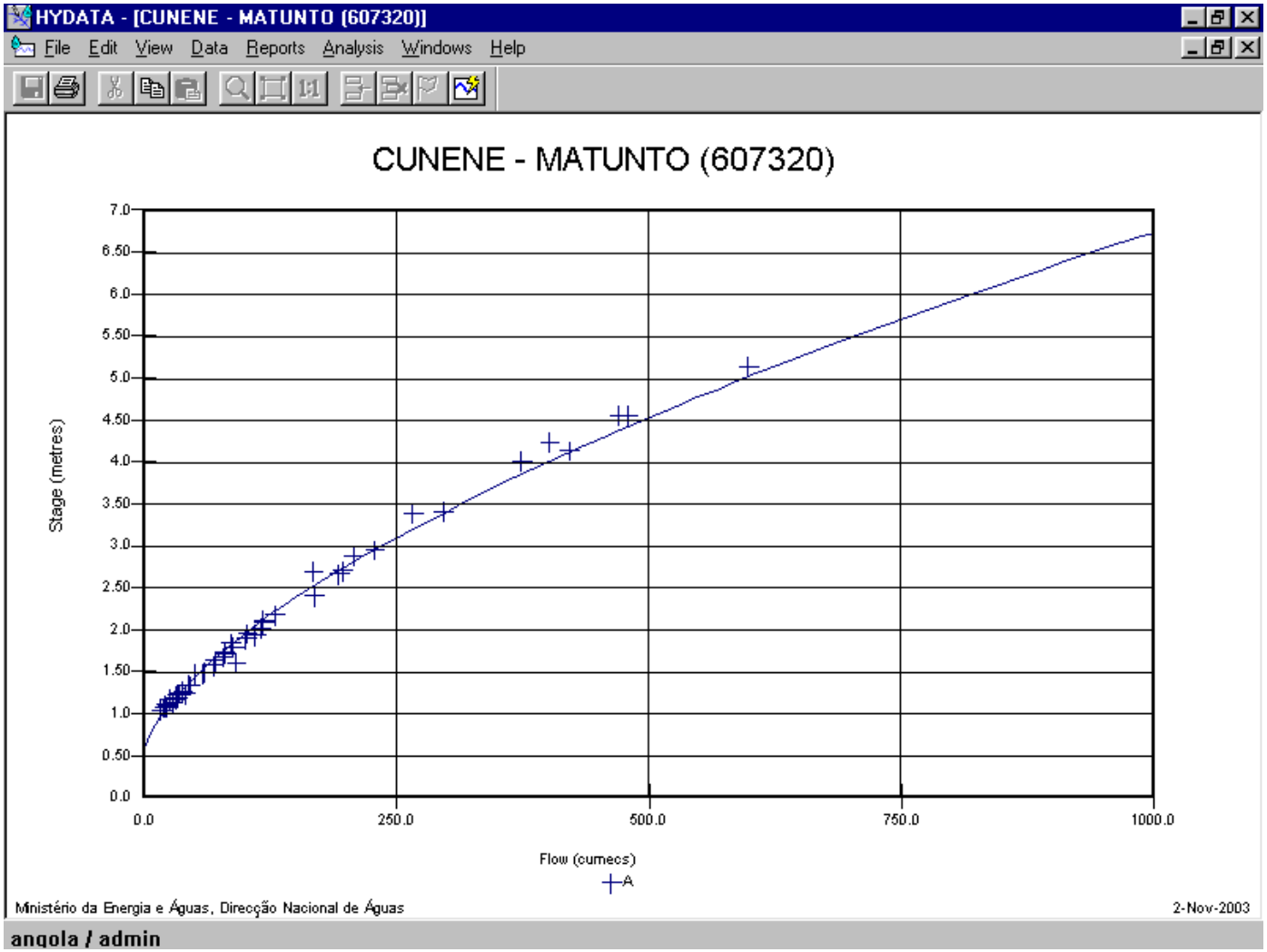
Rating curve 603009, only B-rating?! 86 measurements in the period **nov 68-jul 75. All measurements registered and used ? NO!**



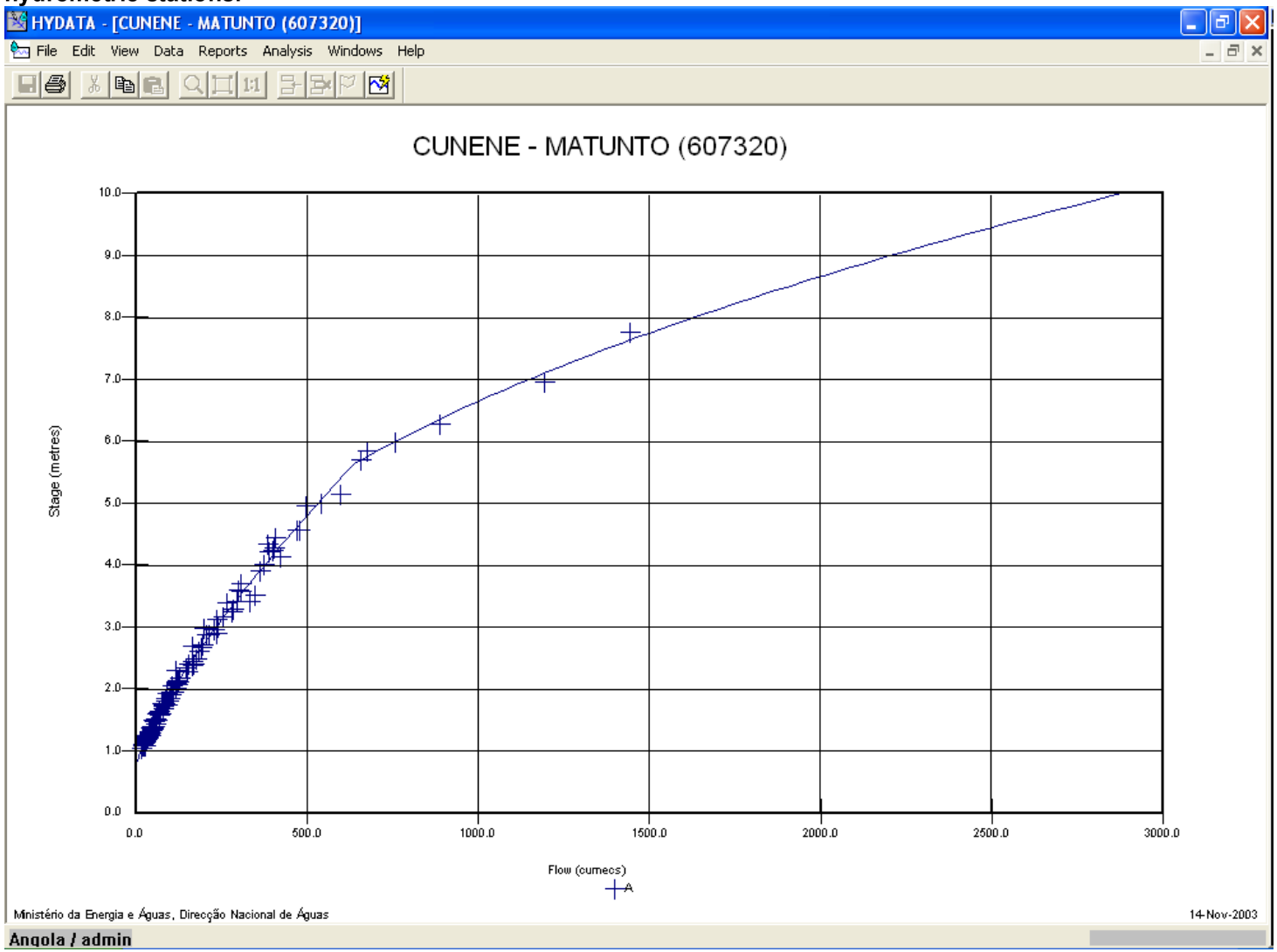
Rating curve 603009, NEW! Based on 98 measurements in the period oct 66-jul 75. All measurements are registered and used ! These measurements are found qualified for the whole period with water level, oct 1964 – sep 1975.



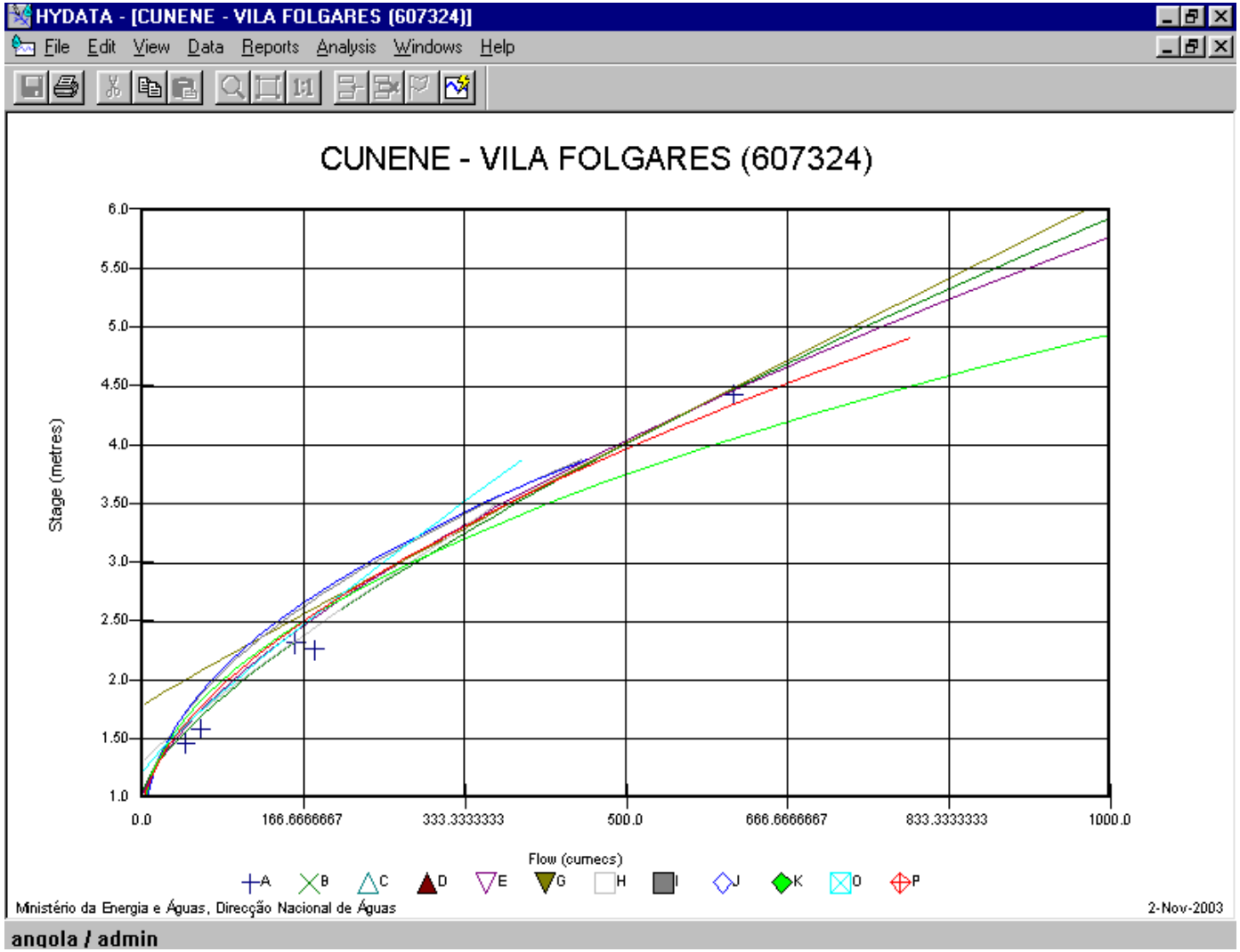
Rating curve 607320, should be brushed up?! But here are a lot of measurements in the period **oct 67-jul 75. All measurements are not used, and some are not registered into the Hydata-database (65-67, 74-75, and some in 1973) ! This will be done by Arnt.**



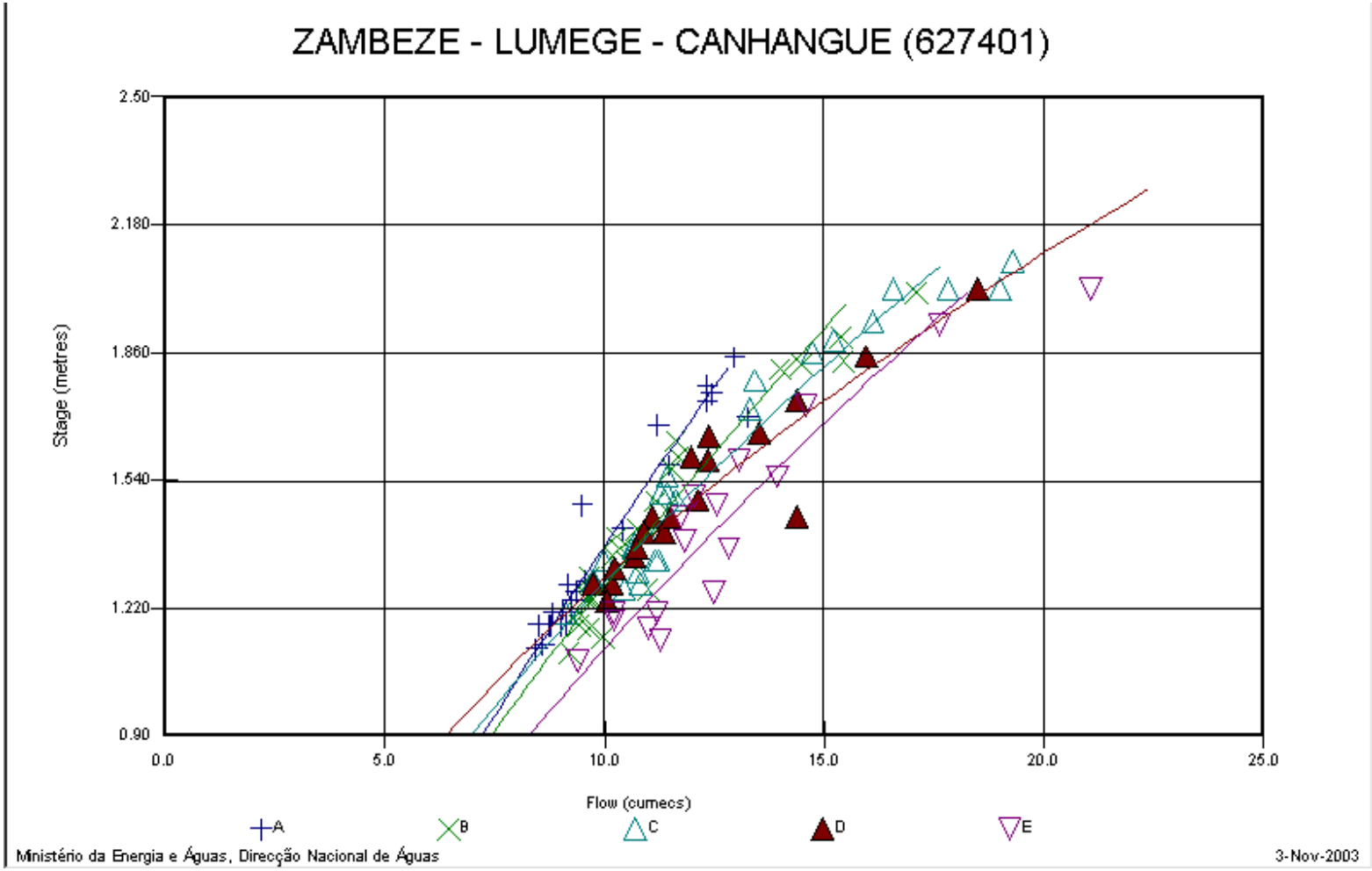
Rating curve 607320 – new! The old rating was made from 54 measurements in the period **oct 67-jul 75. We found another 80 useful measurements (65-67, 74-75, and some in 1970 and 1973)! All useful measurements are now used, and we found that one rating is OK for the whole period of data 1965 - 1979. I think that this stability is an important quality mark that should be noticed when you plan rehabilitation and restart of Angolan hydrometric stations.**



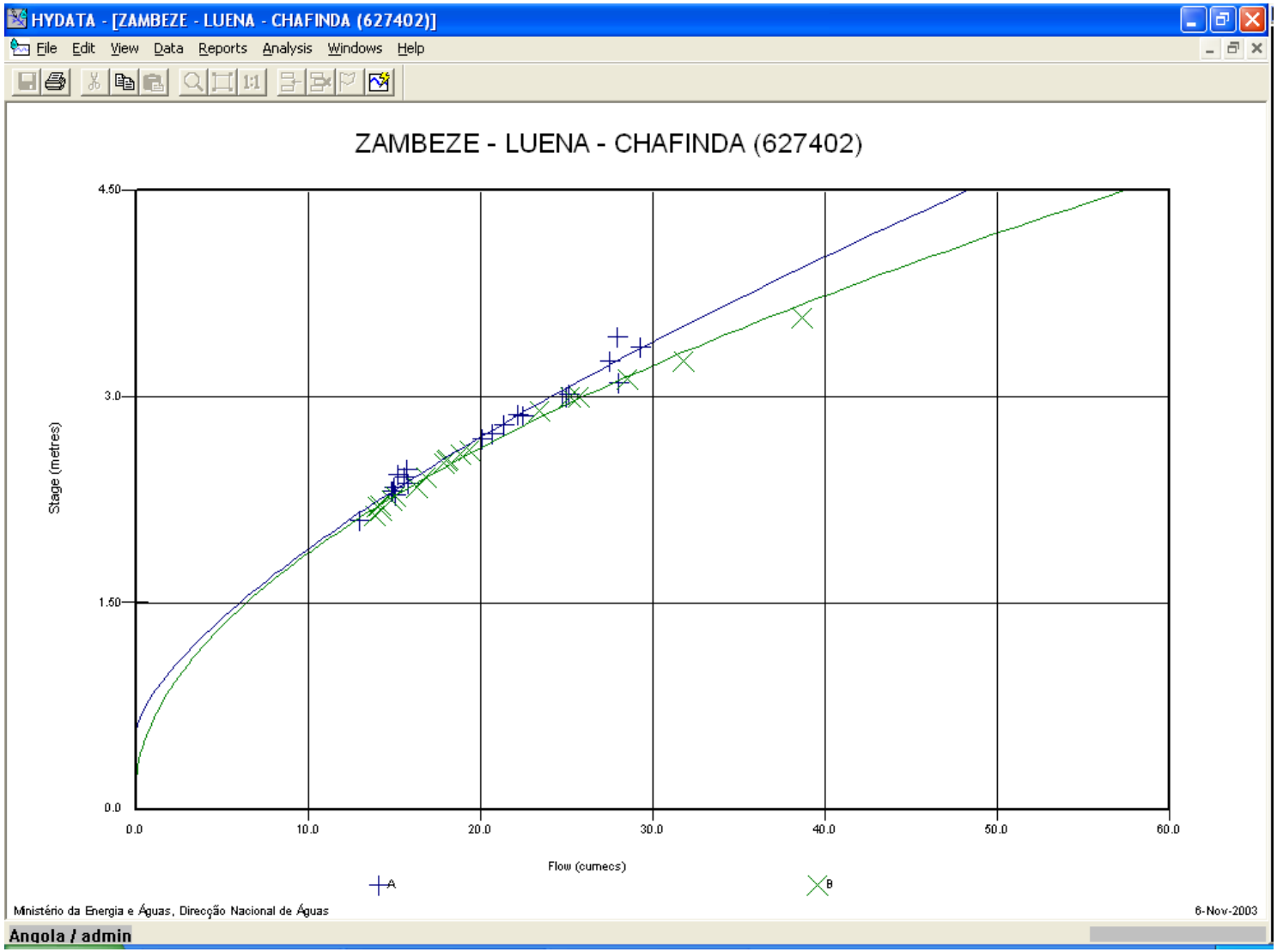
Rating curve 607324, needs reestablishment! But here are a lot of measurements in the period **Oct 67-Feb 84.**
NB! Has been corrected, completed and finally re-established (see archive and database)



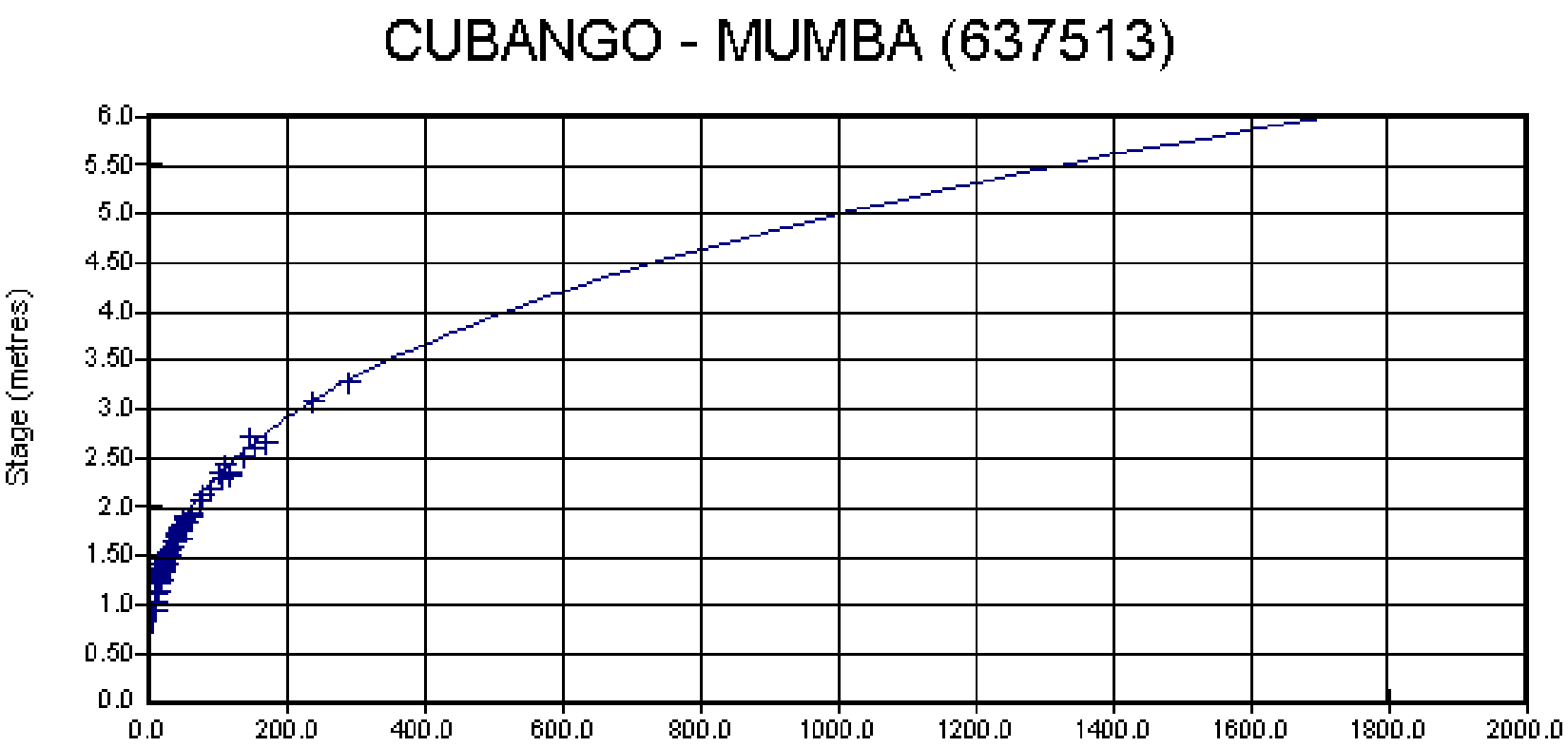
Rating curves 627401, SEEMS FUNNY, but are OK after a closer check! Actual levels are 0.9 – 2.5 m.
Here are 110 measurements in the period sep 65-mar 71.
The rating is made by Olav.



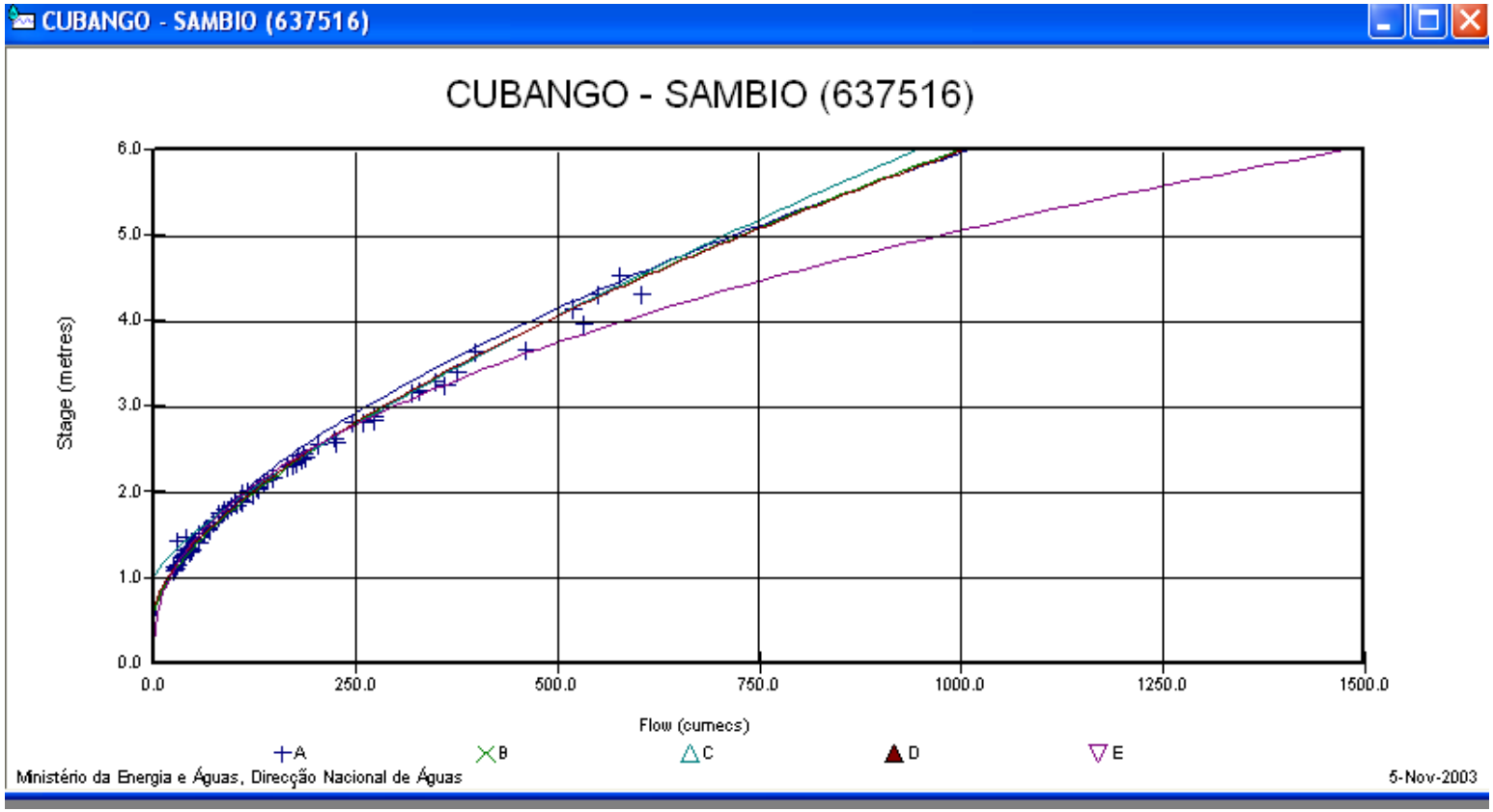
Rating curve 627402, made 06-nov-2003. Actual levels are 2.1 – 4.3 m. Here are 43 measurements in the period **oct65-jul68.**
The station has registered water level from oct 65 – sep 69.



Rating curve 637513, OK ?! Actual levels are 0.5 – 5 m. Here are 78 measurements in the period **may 68-jul 75.**

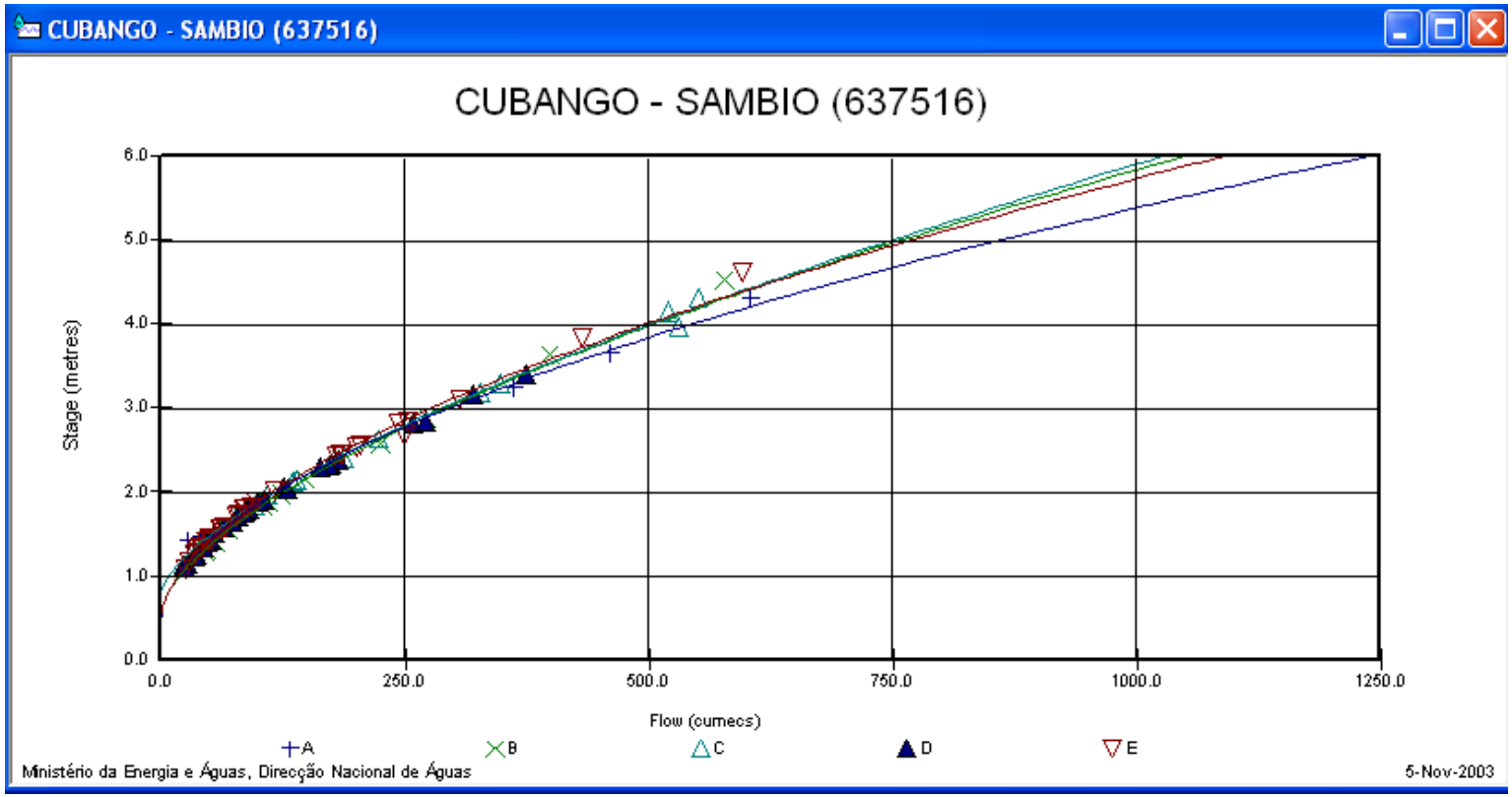


Rating curve 637516, rating A & E? – other OK ?! Actual levels are 1 – 5.5 m. Here are 103 gaugings in the period **oct 67-jul 75.**
Gaugings should be re-rated (rate name A-E) in database to fit actual ratings (would give a better picture, see fig).
NB! Gaugings in A-period seem dubious. Top of E-rating does not fit high gaugings in E-period!

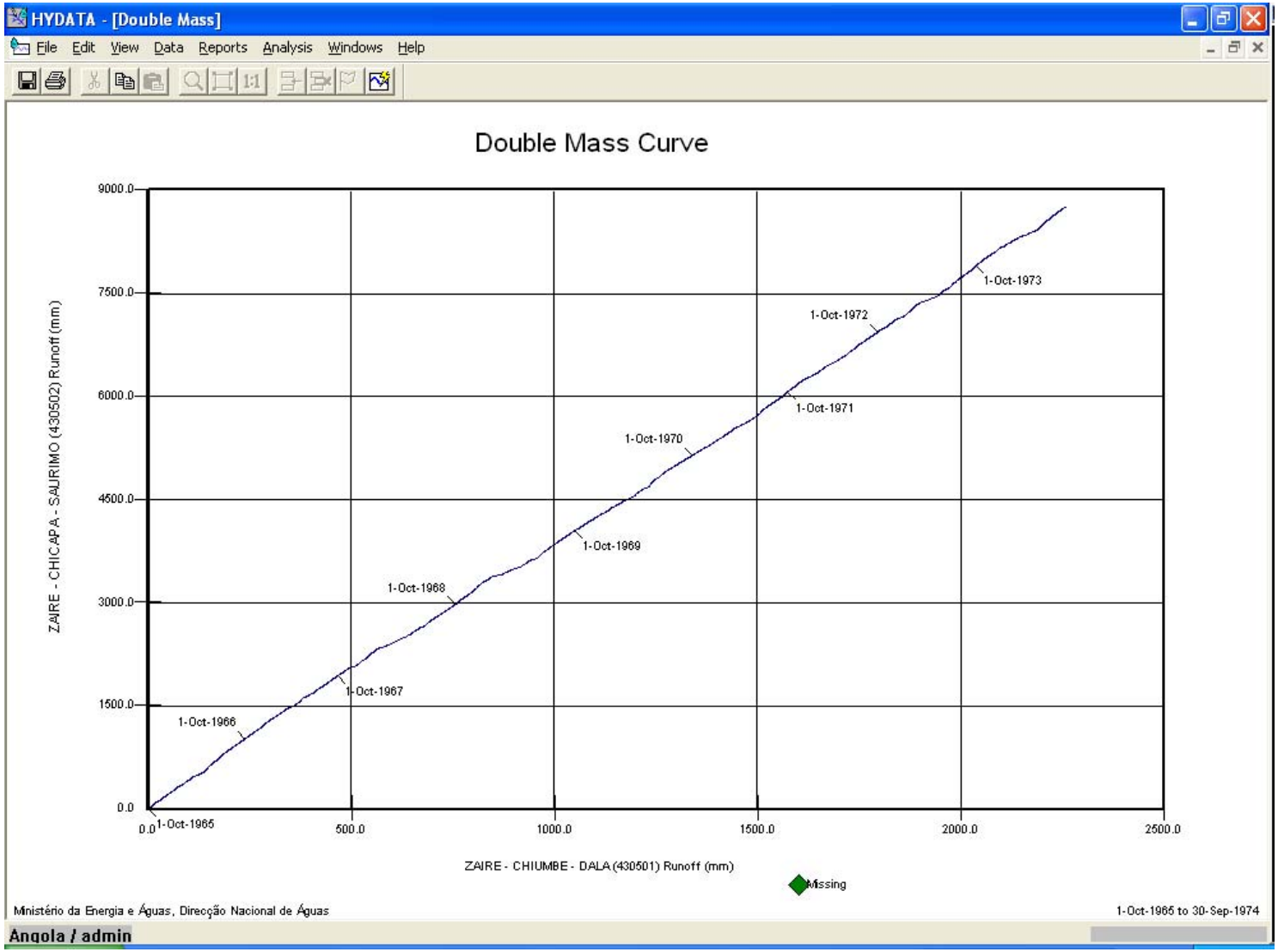


See new rating next side

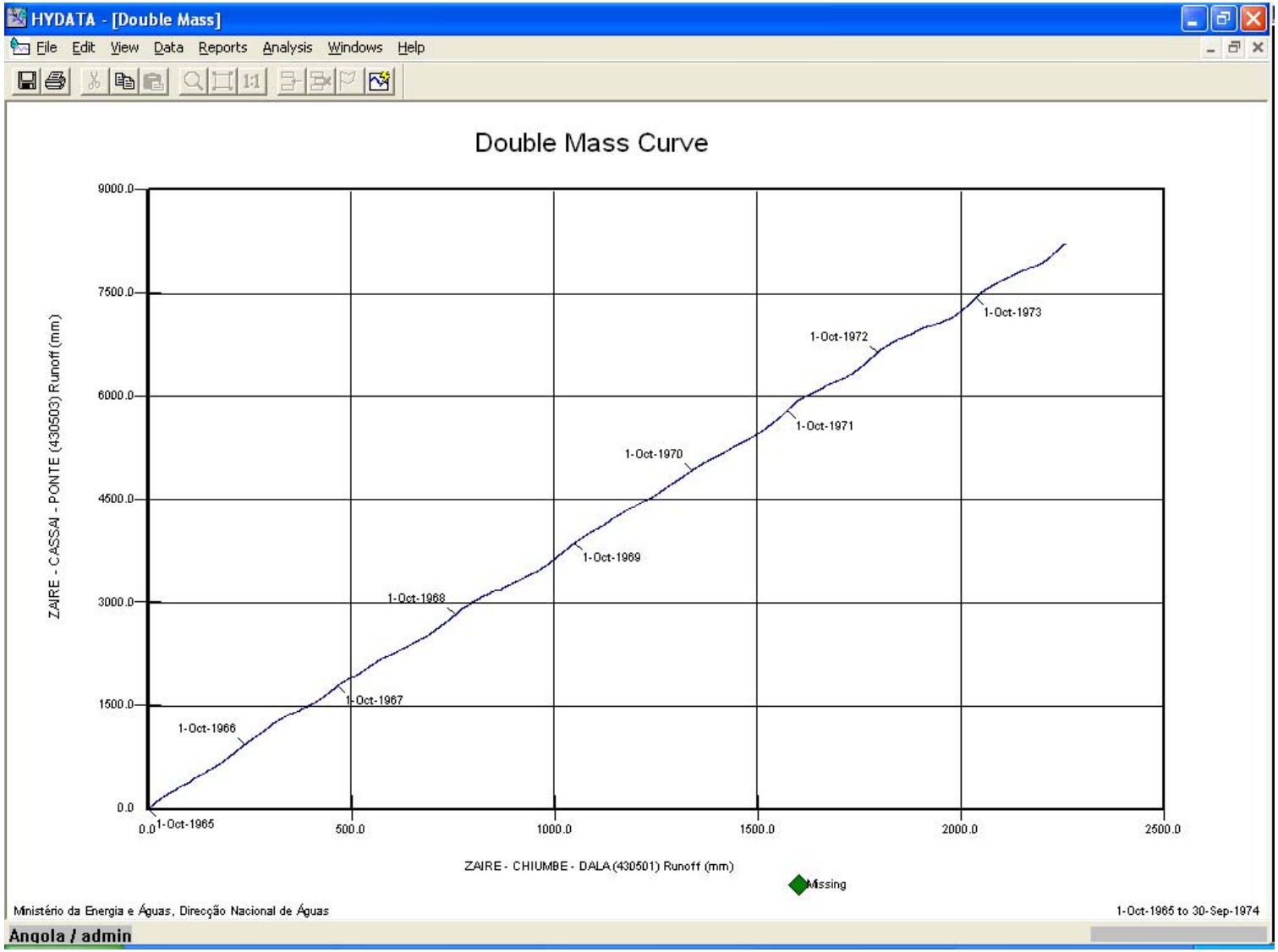
Rating curve 637516, new rating A - E! Actual levels are 1 – 5.5 m. Here are still 103 measurements in the period **oct 67-jul 75.**
Measurements are re-rated (rate name A-E) in database to fit actual ratings (see fig).
NB! First 2 measurements in A-period seem dubious (and are not used). A- & B-measurements fit well together – and A- & B-rating are actually the same. Top of D-rating has no high measurements and is run by "a strong" double measurement just below 3 m .



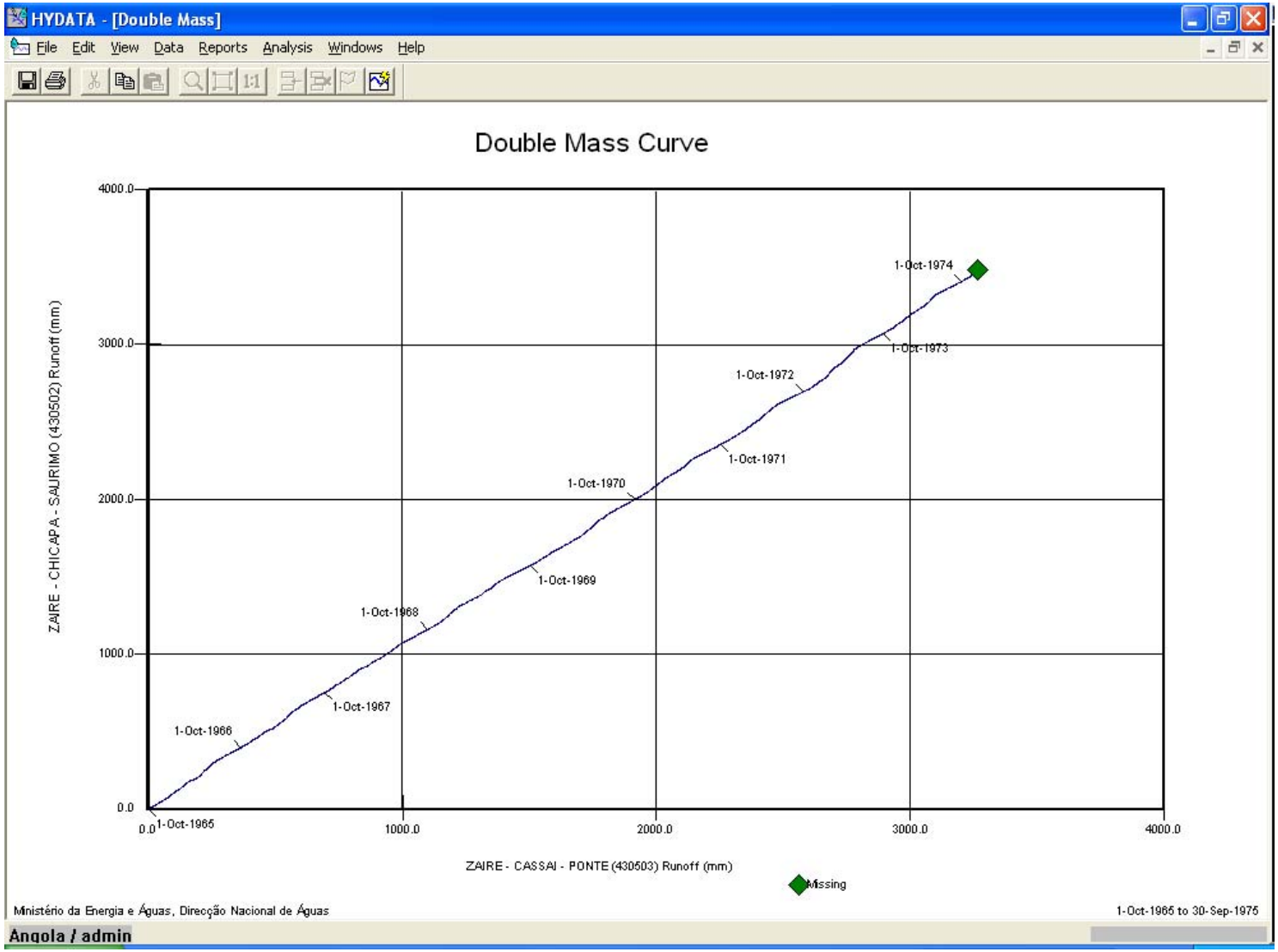
D-MASS, ZAIRE 430501 & 430502, SEEMS OK THE 10 YEARS OF COMMON DATA.



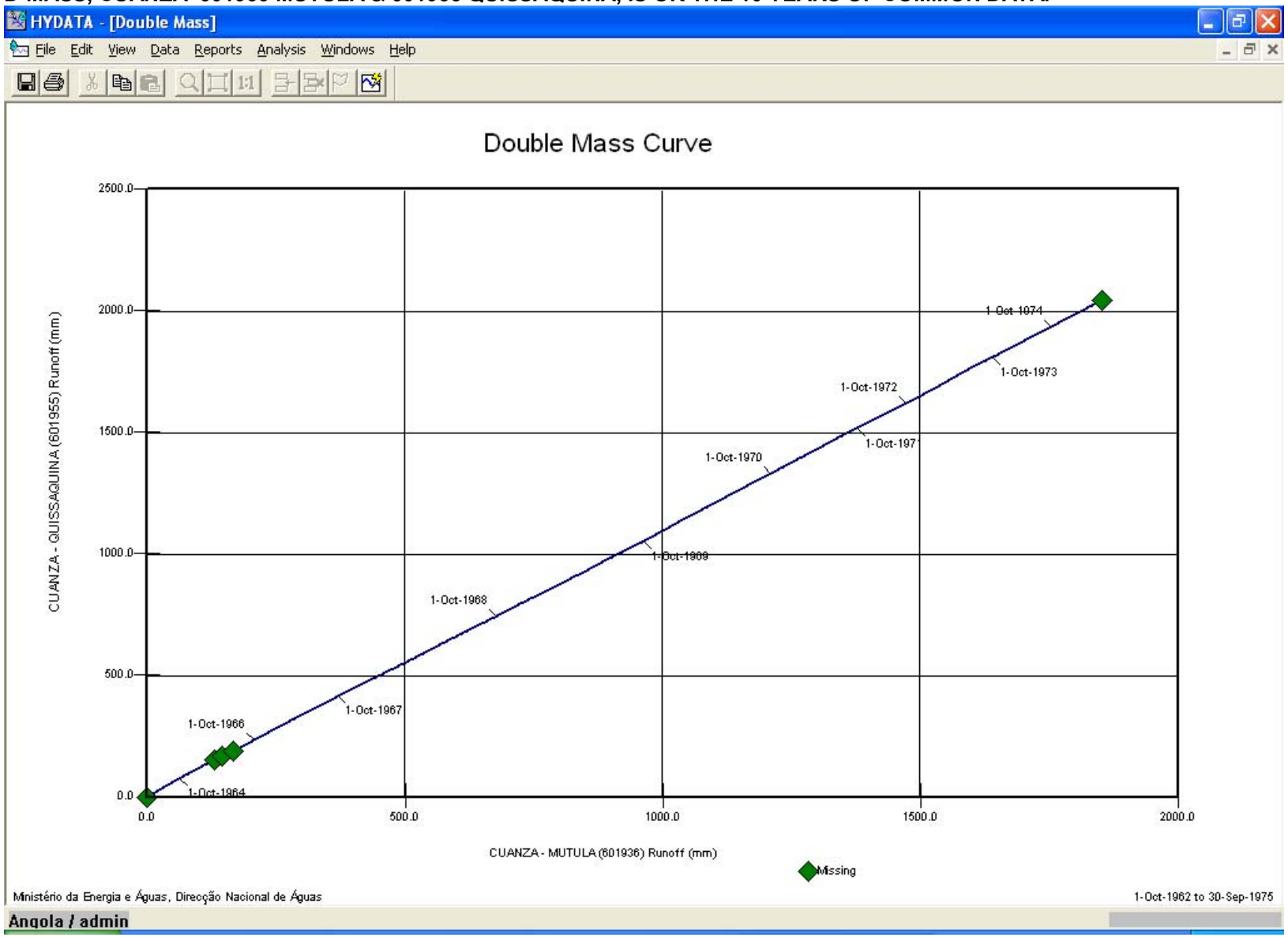
D-MASS, ZAIRE 430501 & 430503, SEEMS OK THE 10 YEARS OF COMMON DATA.



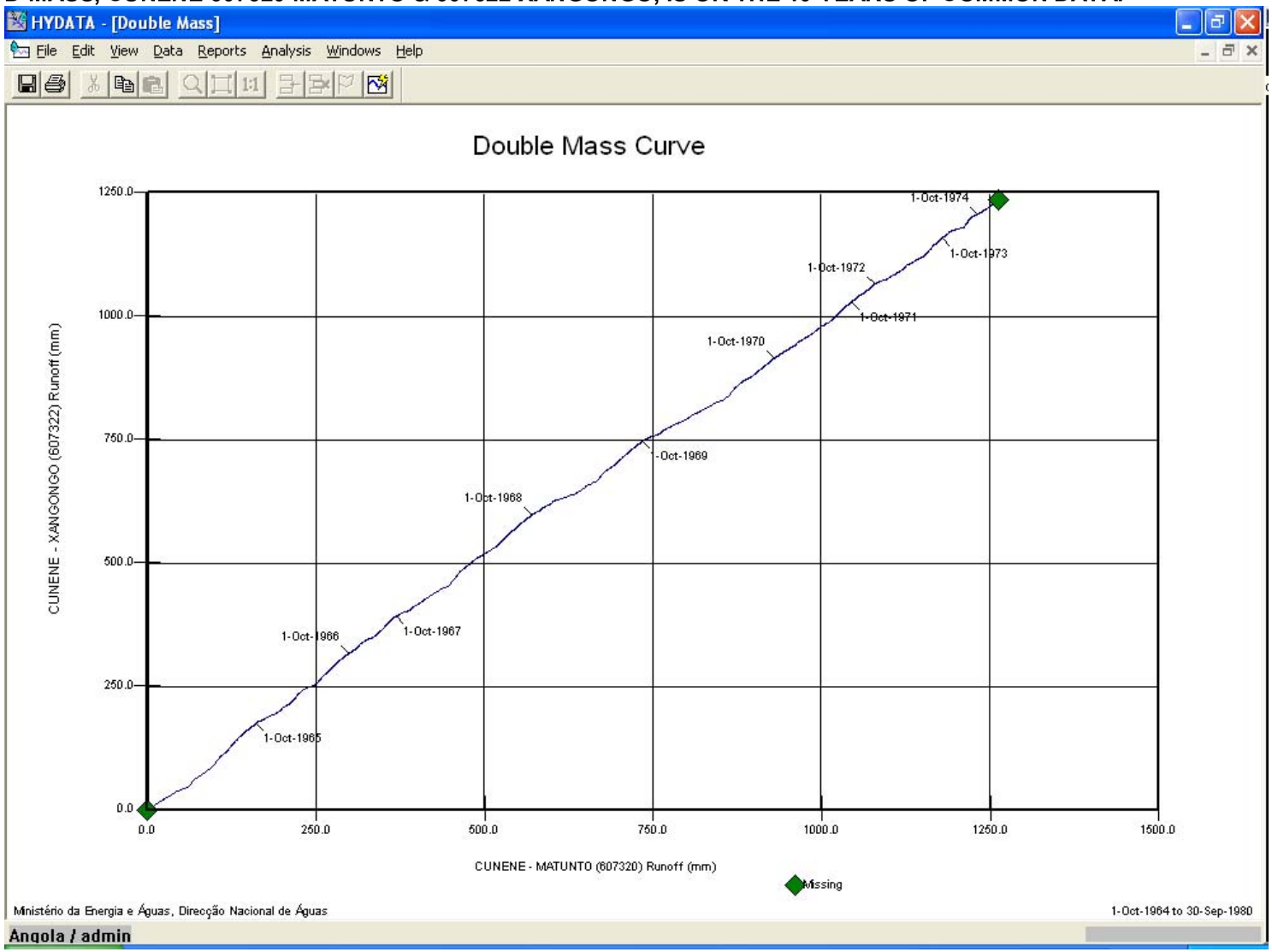
D-MASS, ZAIRE 430503 & 430502, SEEMS OK THE 10 YEARS OF COMMON DATA.



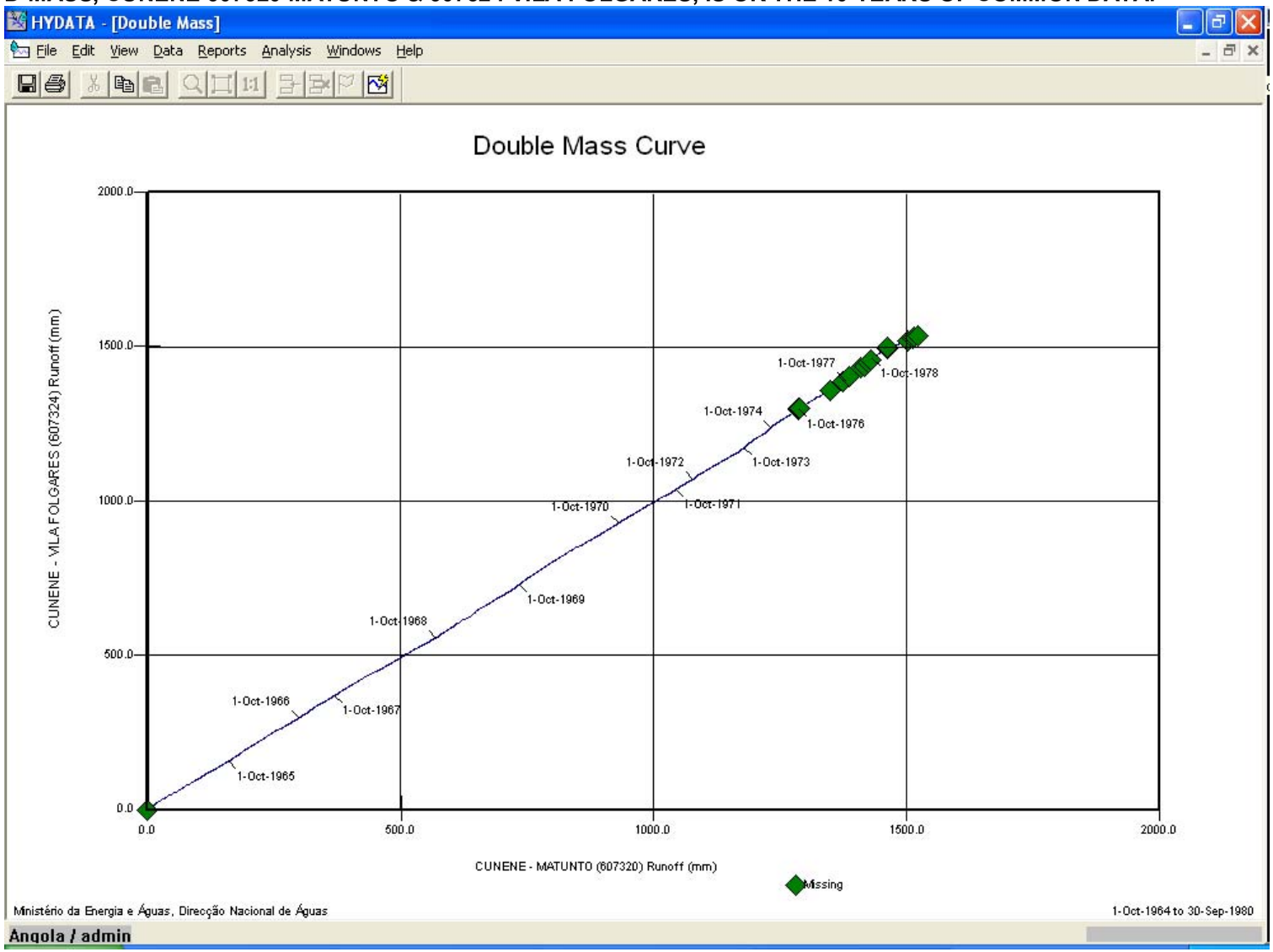
D-MASS, CUANZA 601936 MUTULA & 601955 QUISSAQUINA, IS OK THE 10 YEARS OF COMMON DATA.



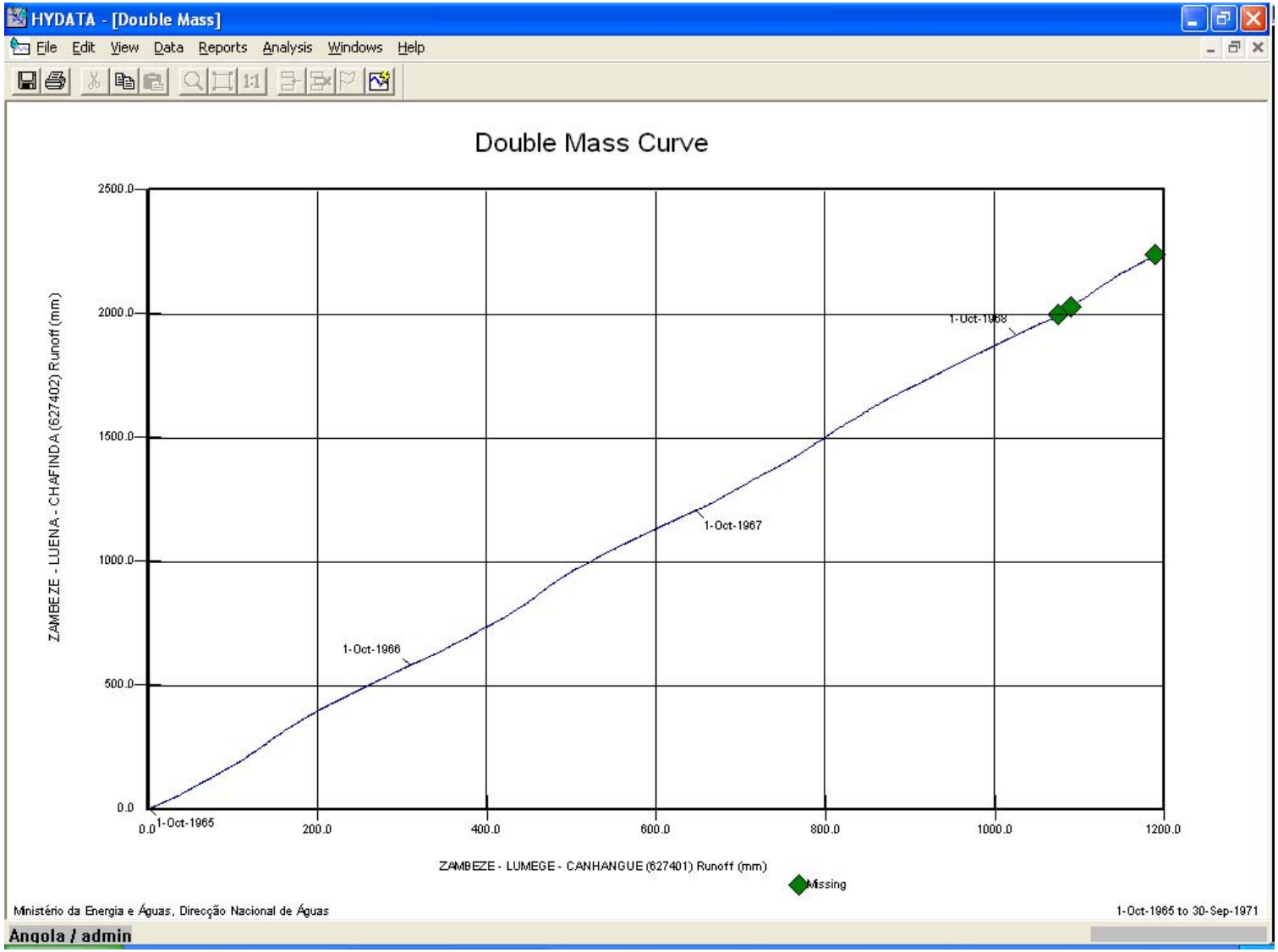
D-MASS, CUNENE 607320 MATUNTO & 607322 XANGONGO, IS OK THE 10 YEARS OF COMMON DATA.



D-MASS, CUNENE 607320 MATUNTO & 607324 VILA FOLGARES, IS OK THE 10 YEARS OF COMMON DATA.



D-MASS, ZAMBEZE 627402 & 627401, SEEMS OK THE 3 YEARS OF COMMON DATA.



Ministério da Energia e Águas, Direcção Nacional de Águas

List of primary stations and their details, evaluated October - November 2003 and March - April 2004
Primary stations after proposale from Mr. Paulo Emilio Mendes

Only stations marked BAD or OK in column D-MASS are fully evaluated. ok? and + should be given priority for further work

Number	Latitude	Longitude	Elevation	Area	Q/sq km	Level	Q	Q-measure	D-MASS	Name
	*:min:sec	*:min:sec	(metres)	(sq km)	l/s x km^2	period	period	period	status	
					67-68/72-73	date-date	date-date	date-date	OK/+/?/BAD	
430502	9:29: 0 S	20:21: 0 E	1070	6250	11,1/10,3	oct65-sep74	oct65-sep74	oct65-sep73	OK	ZAIRE - CHICAPA - SAURIMC
601101	7:21: 0 S	14:54: 0 E	670 (96?)	484	11,2/?	oct67-sep71	oct67-sep71	dec66-okt70	+	M'BRIDGE - LOA - FAZENDA LOA
601301	7:45: 0 S	15: 5: 0 E	900	182	?/3,8	oct67-sep73	oct67-sep73	mar68-aug74	+	LOGE - LUQUIXE - BARRAGEM
601701	8:36:15 S	13:33:26 E	36	10660	?/6,0	aug68-dec73	aug68-dec73	oct68-may75	OK	DANDE - PORTO QUIPIRI
601706	8:24:45 S	14:36:20 E	450	5191	?/12,0	oct70-jun75	oct70-jun75	sep72-aug74	OK	DANDE - PONTE DE QUIBAXE
601804	8:55: 0 S	13:40: 0 E	10	8053	5,1/6,0	may59-sep73	may59-sep73	feb62-oct80	OK	BENGO - CABIRI
601955	9:48: 0 S	15:13: 0 E	780	116400	9,4/5,5	apr64-sep64	apr64-sep75	none	OK	CUANZA - QUISSAQUINA
602506	10:16: 0 S	14:48: 0 E	1050	6332	4,8/6,6	nov64-sep81	oct67-sep73	feb68-mar81	?	LONGA - QUISSUCA
603004	10:59: 0 S	14: 5: 0 E	45	20352	9,0/8,0	oct64-jun75	oct64-jun75	dec67-aug76	OK	QUEVE - CACHOEIRAS DA BINGA
603403	11:49: 0 S	13:57: 0 E	190	878		jun66-	none	none	BAD	EVALE - LOETO DESCARREGADOR
603502	11:59: 0 S	14: 0: 0 E	240	3842	10,5/?	oct66-jul75	oct67-jul75	dec67-jun81	+	BALOMBO - CANJALA
603701	12:15: 0 S	13:45: 0 E	45	2119	4,0/3,0	nov64-aug82	oct67-aug82	feb68-sep73	+	CUBAL DA HANHA - HANHA
603808	12:44: 0 S	14:27: 0 E	1000	8296	11,3/?	feb62-sep70	nov61-sep70	apr63-sep67	+	CATUMBELA - LOMAUM
604603	12:59: 0 S	13: 9: 0 E	7	1		oct52-jul83	none	jul73-nov76	+/?	COPOROLO - DOMBE GRANDE
606701	15:35:23 S	12:49:36 E	360	1		feb70-apr70	none	none	bad?	BERO - TAMPA (DESCARREGADOR)
607320	15:22: 0 S	15:17: 0 E	1130	41034	6,4/3,2	feb65-jun75	feb65-jun75	feb65-jul75	OK	CUNENE - MATUNTO
607324	14:54: 0 S	15: 5: 0 E	1190	35636	6,9/3,8	jun62-jun75	oct62-jun75	jul63-feb84	OK	CUNENE - VILA FOLGARES
627402	11:55: 0 S	20:27: 0 E	1160	2970	7,9/?	oct65-sep68	oct65-sep68	oct65-jul68	OK	ZAMBEZE - LUENA - CHAFINDA
637516	17:53: 0 S	20: 4: 0 E	1060	86800	3,4/1,2	oct63-jul75	oct66-jul75	oct67-jul75	OK?	CUBANGO - SAMBIO

Denne serien utgis av Norges vassdrags- og energidirektorat (NVE)

Utgitt i Oppdragsrapportserie A i 2004

Nr.1 Per F. Jørgensen, Peter Bernhard, KanEnergi AS: Elproduksjon basert på biobrensler. Teknisk/økonomisk potensial (s.)

Nr.2 Jan Sandviknes , Kjelforeningen-Norsk Energi: El-gjenvinning i energiintensiv industri. Teknisk/økonomisk potensial (s.)

Nr.3 Roger Sværd: Vannstander i Rotvikvatnet, Salangen kommune, Troms. Overføring av Sommarsetelva til Rotvikvatnet. (35 s.)

Nr.4 Eli Alfnes og Hans-Christian Udnæs: Satellite-observed Snow Covered Area and spring Flood Prediction in the HBV-model (26 s.)

Nr. 5 Hervé Colleuille: Filefjell - Kyrkjestølane (073.Z) Grunnvannsundersøkelser - Årsrapport 2003 (17 s.)

Nr. 6 Hervé Colleuille: Groset forsøksfelt (016.H5) Grunnvanns- og markvannsundersøkelser (22 s.) - Årsrapport 2003 (28 s.)

Nr. 7 Hervé Colleuille: Skurdevikåi tilsigsfelt (015.NDZ) Grunnvannsundersøkelser - Årsrapport 2003 (21 s.)

Nr. 8 Lars-Evan Pettersson: National strategy plan for rehabilitation of the hydrometric network in Angola (31 s.)

Nr. 9 Arnt Eivind Bjøru: Quality check - historical hydrological data in Angola. (20 s.)