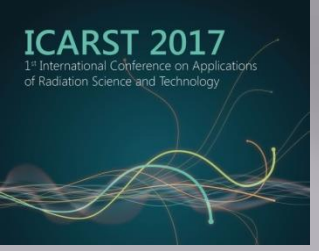

THE USE OF NUCLEONIC GAUGE JTTX IN THE PORT OF NANTES SAINT NAZAIRE

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Content of the presentation

1. The problem
2. Principle of the measurement
3. Equipment and examples
4. The concept of Navigability Depth limit
5. Consideration on radiological safety
6. Results and conclusion

The problem

Harbour basins, navigation channels but also dam reservoirs are subject to sedimentation of fine particles (mud)

This material accumulates at the bottom and leads to

- **For harbours : diminution of the navigable depth**
- **For Dams :**
  - **diminution of the water storage capacity of the reservoir**
  - **Risk of blockage of the dam's gates which can have a critical impact on the structure in case of flood**

The remediation solutions are mainly dredging and flushing. The volume of material to be removed can be very huge, for ex. approx. 10 Mm3/y in Nantes harbour leading to a very high cost.

The optimization and management of these solutions require an efficient and reliable monitoring system.

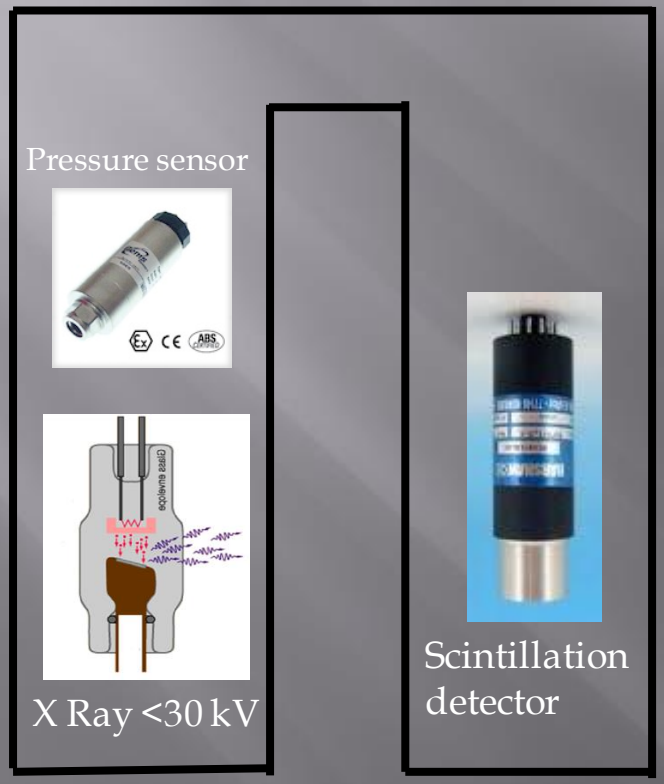
Some words about Nantes Saint Nazaire Port

NANTES SAINT-NAZAIRE PORT

With more than 25 million tonnes of traffic handled in 2015, Nantes – Saint Nazaire is the leading port on France's Atlantic Seaboard and the fourth port authority. Its port area extends over a 65-kilometre stretch along the Loire Estuary. A very diverse range of port facilities is located on sites spanning its upriver and downriver sections.

Principle:
Direct measurement method
X Ray transmission

Principle and main components

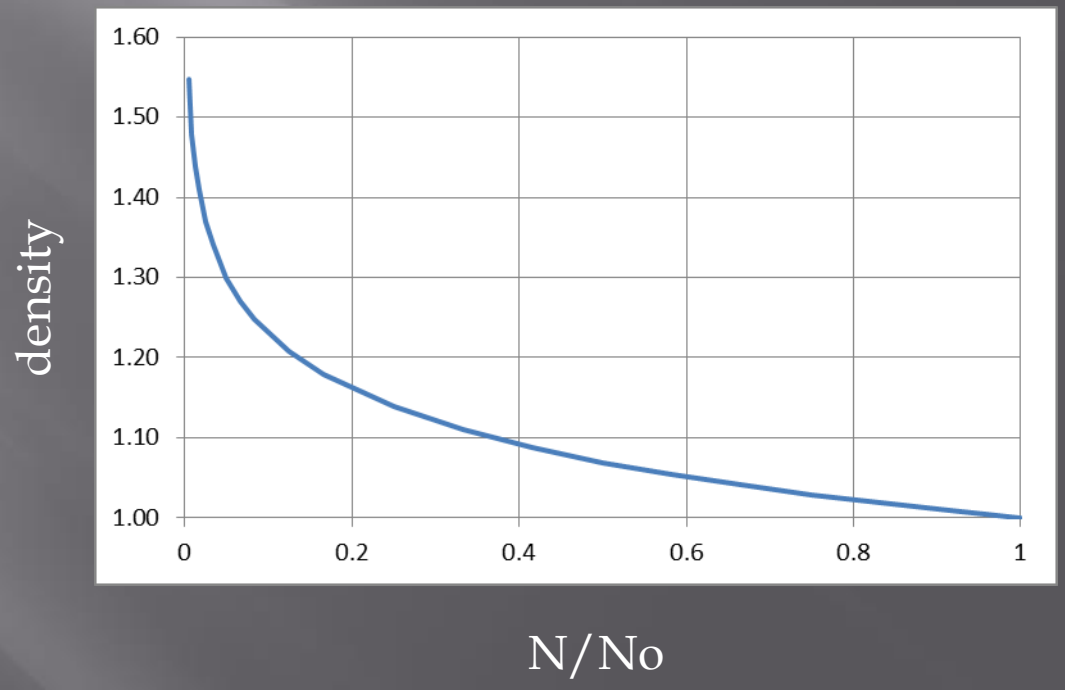


Measurement head on-board

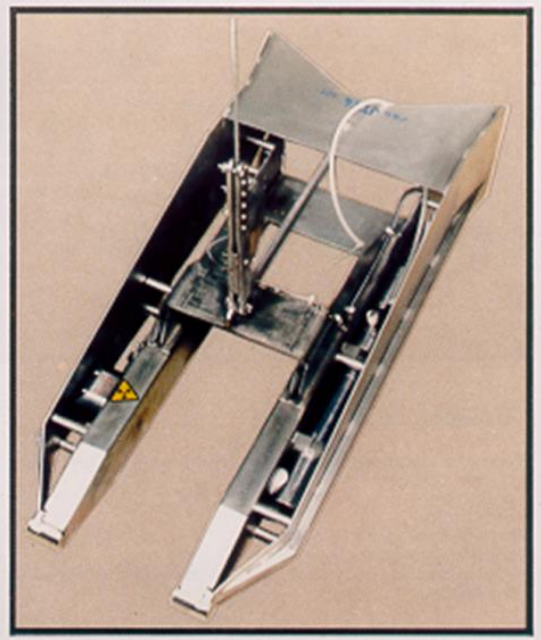
X ray transmission formula

$$d = do + k1(Ln(\frac{N}{No})$$

Where:
d: density of the mixture water-mud
N: signal intensity in the mixture
No: signal intensity in clear water
Do and k1: calibration coefficients



Other measurement tools in use

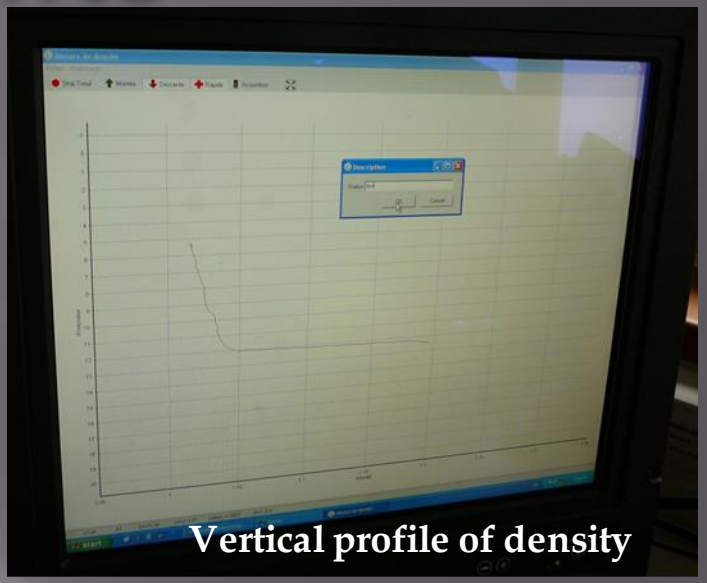


Gamma transmission JTT4
Cs 137: 222 MBq

Gamma back scattering JTD3
Cs 137: 18.5MBq

Surface Units

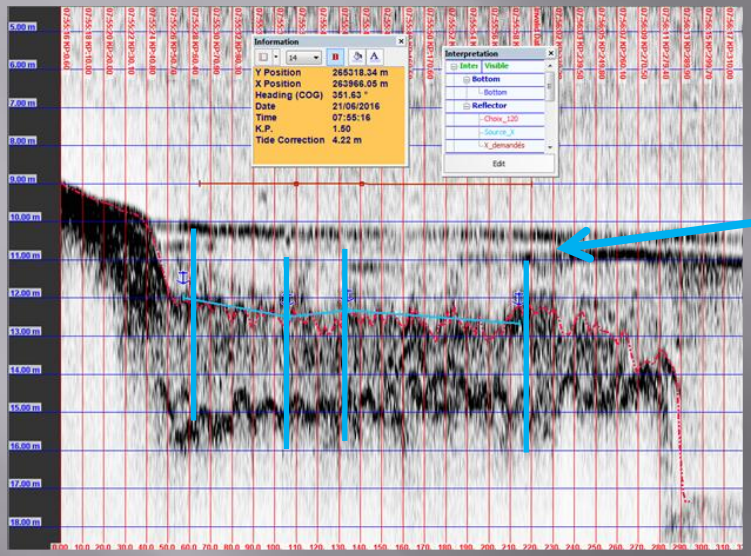
Winch SAR IV : 220 VAC – 2 kW –
2 speeds (max 2 m/s) – max load 150 kg



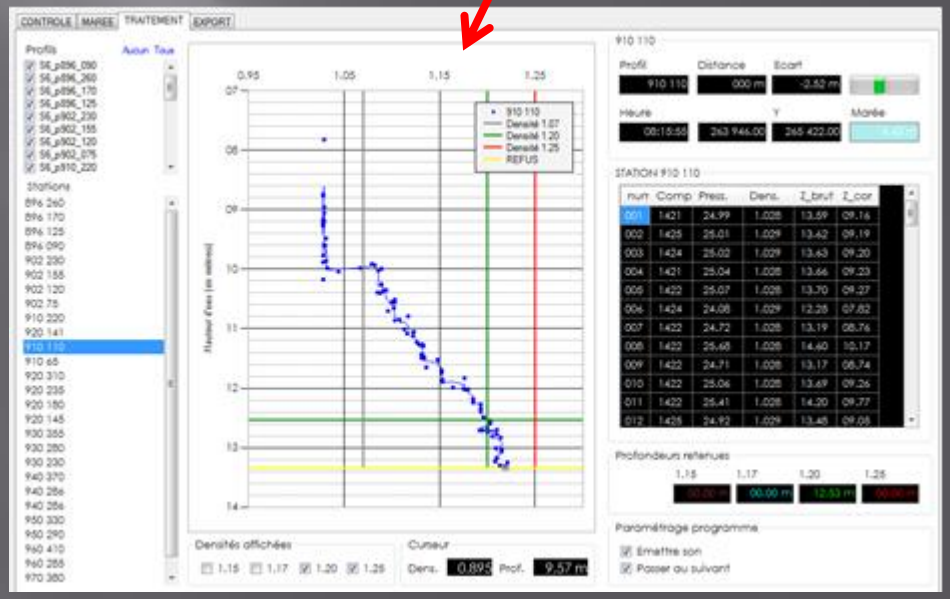
Vertical profile of density

Interface ASTER 2 – winch control-command, signal conditioning and transfer to PC, display of raw measurements

Measurement and data processing

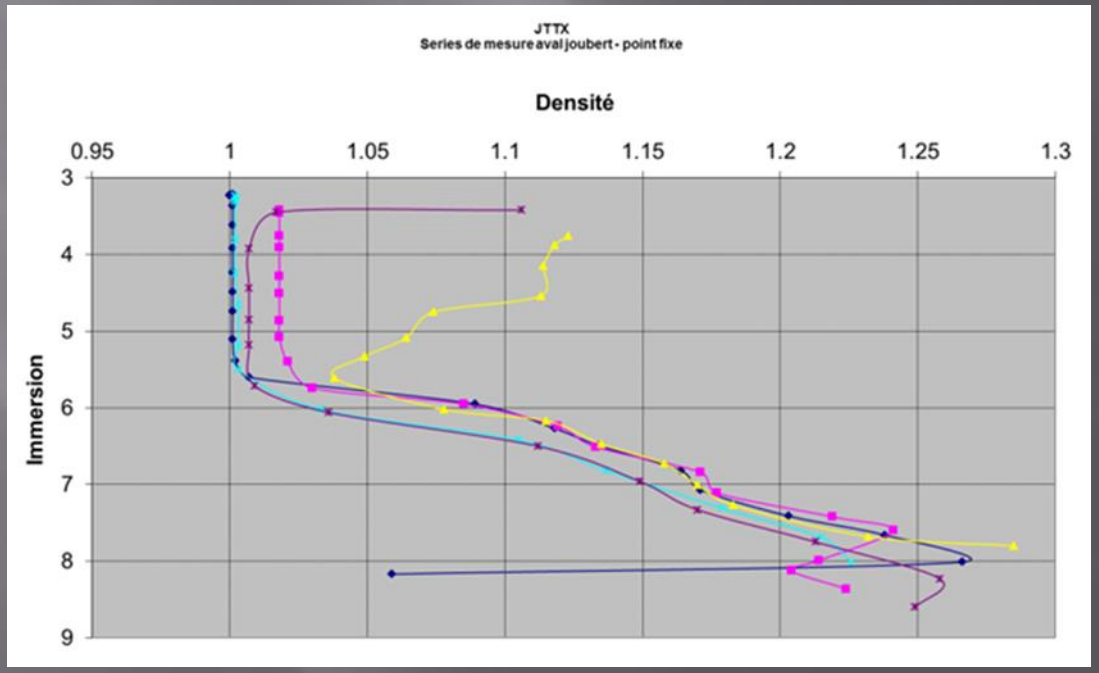


1st step: US mapping (24/200 kHz)
Selection of the profiles
Positions
Gauging (.xml format)

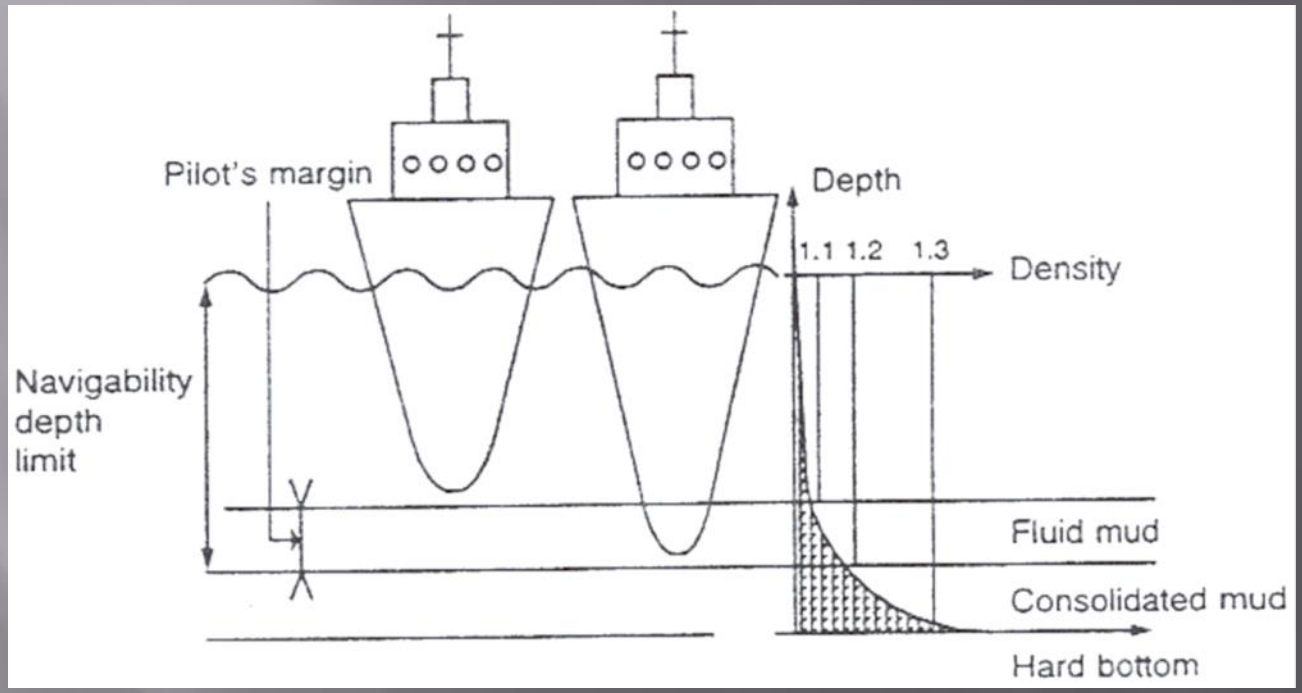


Tide correction
Depth of 1.2

Mapping

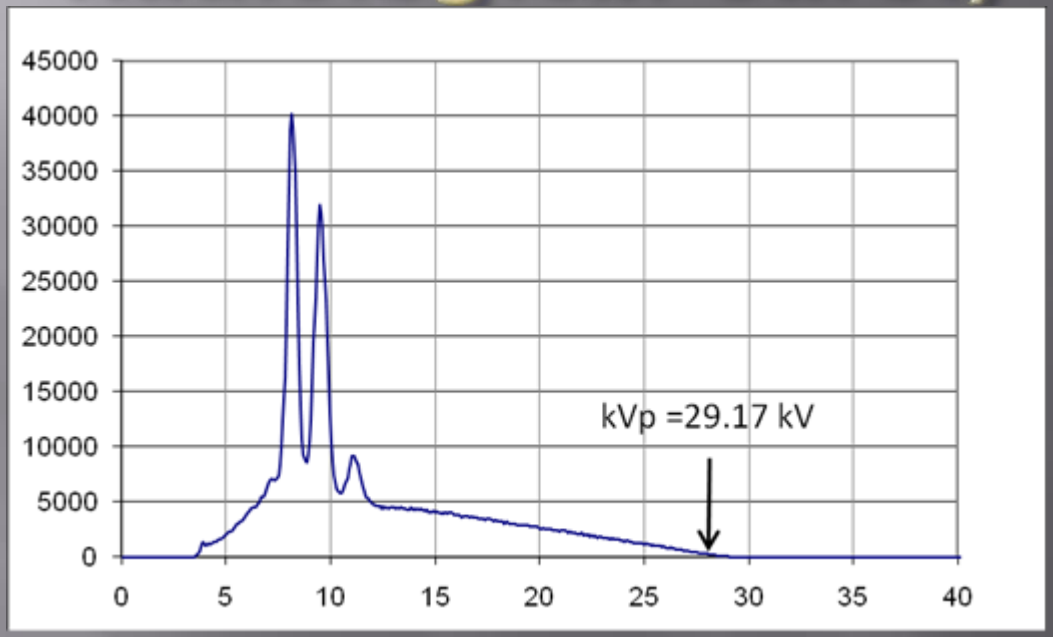


The concept of Navigability Depth Limit



This concept leads to important savings by optimising the dredging works, dredging only when it is necessary.

Consideration on Radiological safety



Spectrum of the X Ray generator emission < 30 kV
Dose rate at 10 cm of any accessible point < 1µSv/h
Safety switch allowing the emission only under water

In these conditions the system doesn't require license from the Nuclear safety Authority
Public Health Code : Article R1333-18

AND : no source thus no issue if the gauge is lost

Results and conclusion

In Nantes Saint Nazaire : dredging works for about 10 Mm^3/year (~30M€)

Savings by optimisation approx 10% meaning ~3 M€ per year

Quality control of dredging works > better management > pay for the quantity (mass) which is really removed

Additionnaly optimisation leads to environmental protection aspects because Sediments in harbors are contaminated by heavy metals

Today the port has 2 X ray gauges JTTX in operation and will step by step replace its gauges based on radioactive sources.

THANK YOU FOR YOUR ATTENTION!