Setting the Standard for Automation™

Fertilizer Symposium, 2016

Advanced Measurement Solutions for Fertilizer Plants: Inventory for Product Silos and Non Invasive Density/ Level for Slurries

Standards
Certification
Education & Training
Publishing
Conferences & Exhibits

The International Society of Automation Delhi Section

NUCLEAR DENSITY/ LEVEL MEASUREMENT

EXEMPTED FROM ATOMIC ENERGY BOARD REGULATION

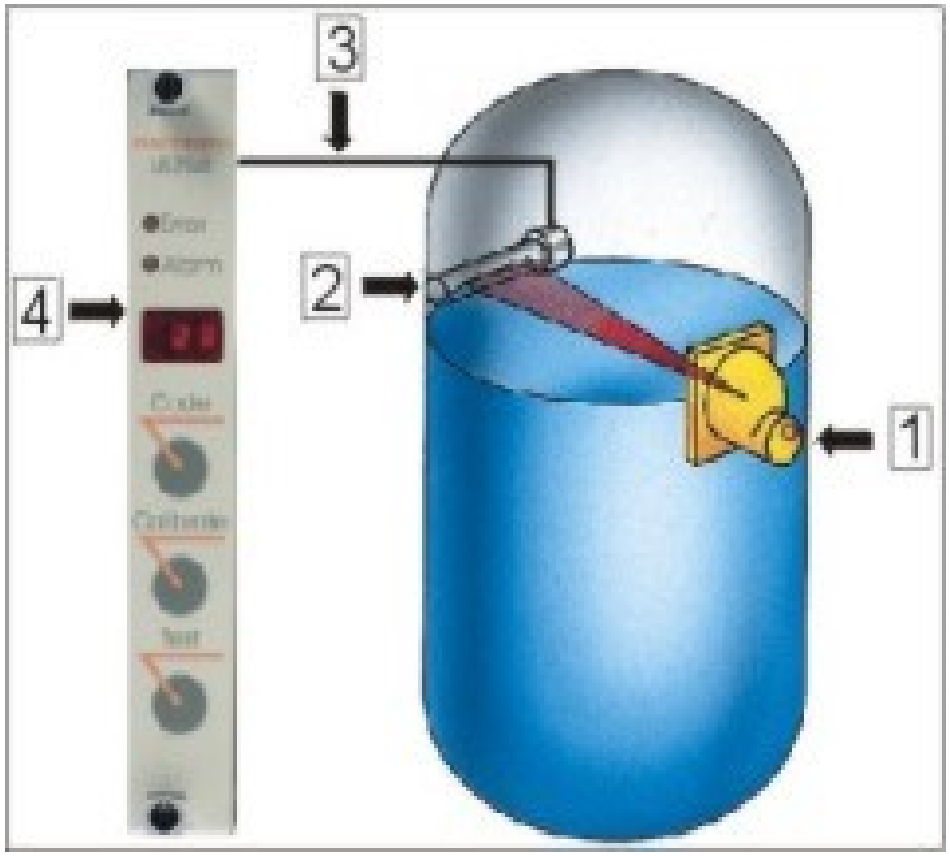
Different methods for Density Measurement

Contact methods (interaction with environment)	Non-contact methods (without interaction with environment)
Hydrostatic density meters	Radiation (radioisotope) density meter
Vibrating density meters	Ultrasonic density meters
	Microwave density meters

Principle : Nucleonic Density and Level Measurement

- Degree of Attenuation of Gamma Rays when flowing through a media
- Advantage : absolute independence from the tank and media parameters.
- Measure density or level in extremely tough operating conditions.
- **Radioisotope Nucleonic method : Only true non-destructive method of level or density measurement in the industry.**

Principle : Nucleonic Density and Level Measurement



1. The source holder with radioactive source
2. Radiation detector - is located outside the tank on the opposite side to the source
3. Electrical signal is transmitted to the processing unit by the cables
4. The processing unit module of prosessing data with communication module with ACS and light indication

VIDEO

BIG QUESTION

Video just demonstrated how advanced the Nuclear Technology is for Density and Level Measurement

Why is it not used UNIVERSALLY everywhere ?

Apprehensions for using Nucleonic Tech.

- **COMMERCIAL STANDPOINT**
  - Strict Atomic Energy Board Regulations
  - End User needs Approvals/ Certification for using the Device
  - Approvals/ Certification required for each and every device imported to India
  - Every Quarterly report to Atomic Energy Board about the usage, safety and healthiness of the device
  - Yearly renewal of NOC of the already installed device for further usage by the end user
  - Requirement Minimum 2 Trained Radiation Scientific Officers in the plant
  - **REASON FOR ABOVE :**
    - Most Conventional devices use Cs-137 and Co-60 as the Gamma source
    - Radioactivity used (around 1.5 GBq) in the devices of the above isotopes is more than the recommended/ exempted limited (100 KBq for Cs-137 and Co-60 source)

Apprehensions for using Nucleonic Tech.

- **HEALTH/ SAFETY STANDPOINT**
  - Radio-isotopes are harmful for the human body
  - Exposure may lead to many health defects starting from head to toe and may also cause infertility
  - Disposal is a problem and source needs to returned to manufacturer
  - **REASON FOR ABOVE :**
    - Most Conventional devices use Cs-137 and Co-60 as the Gamma source
    - Cs-137 and Co-60 are harmful isotopes (By product of Uranium and Thorium)

EPT Nucleonic Density and Level Measurement

- **Solves the Problems/ Apprehensions of Conventional Devices**
  - Uses Na-22 as the Gamma Source
  - Radioactivity is 0.35-0.95 MBq which is approximately 0.024 mCurie (Less than the maximum Exempted by AERB that is 1 MBq for Na-22 Source)
  - No AERB restrictions
  - **Free Import** and **Usage** of the device without any approvals/ certifications
  - Radiation Exposure at 1 meter distance from the device is less than 0.2 microSv/ hr (Yearly exposure is less than 1.8 milliSv/ hr)
    - Current exposure in presentation is around 0.2 microSv/hr (Background)
    - 1 CT Scan exposes to more than 10 milliSv of dose
    - To-Fro flight from Delhi-Kolkata exposes to 240 microSv dose
    - Coal Stockyard exposes to more radiation than this due to Thorium

Nuclear Exposure Safety Limit

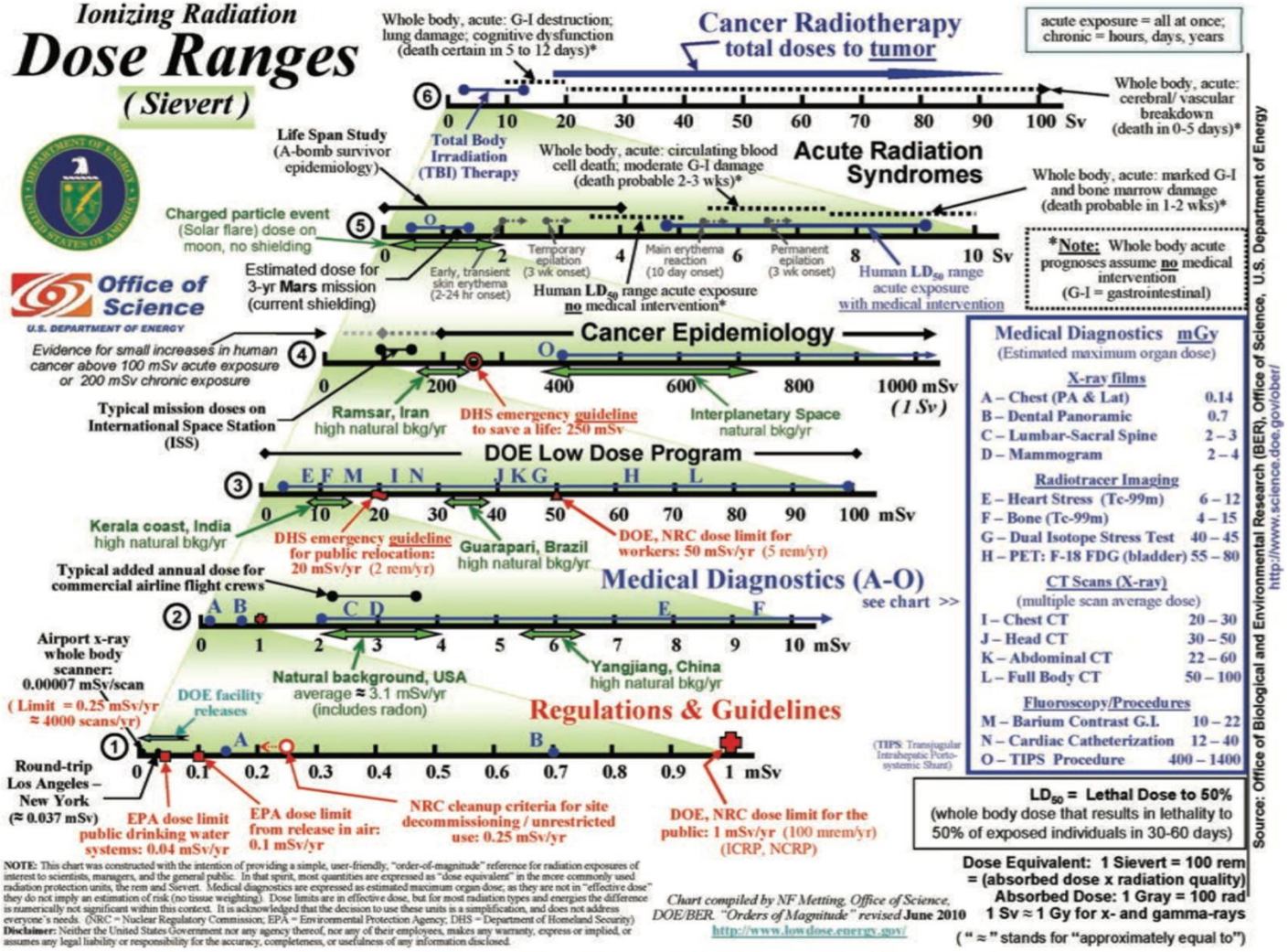


FIGURE 17.4 This chart compiled by Dr. Noelle Metting, Office of Science of the U.S. Department of Energy, puts into perspective the different dose ranges relevant to radiation therapy, diagnostic radiology, and background radiation.

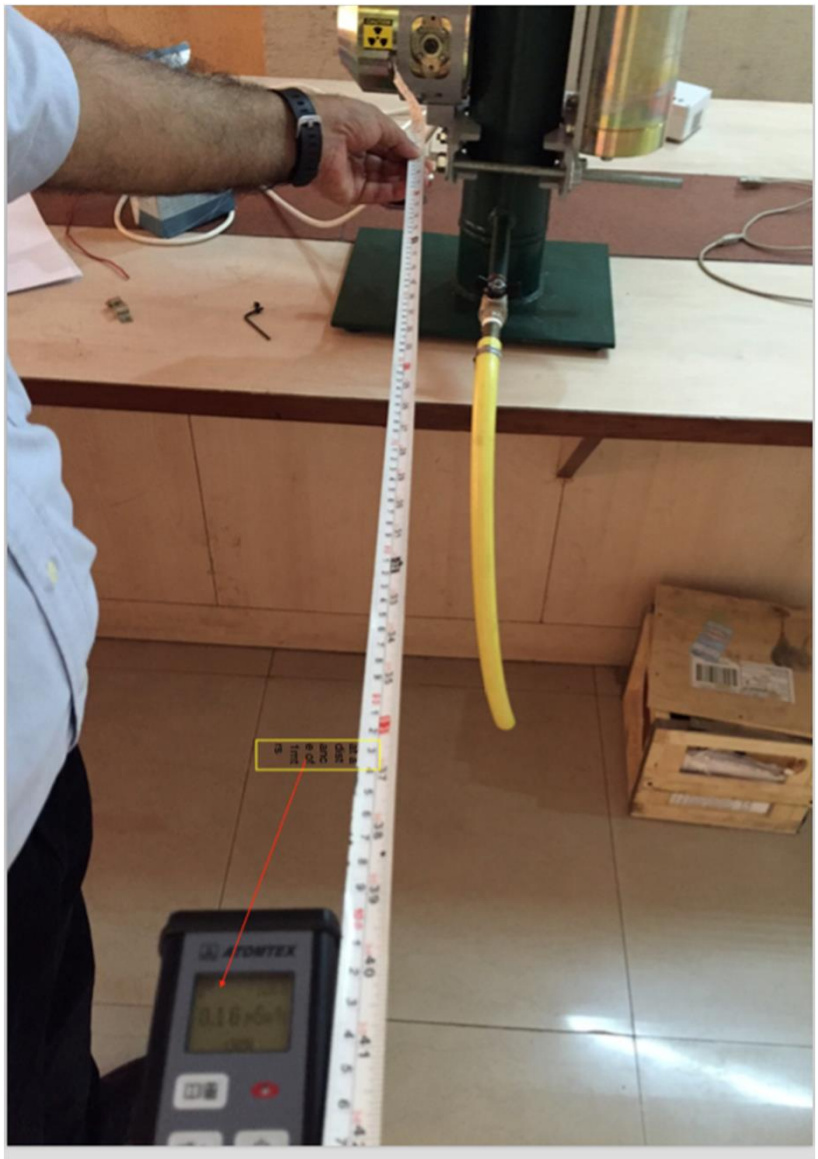
Nuclear Exposure Safety Limity

TABLE 17.5 Summary of Recommended Dose Limits

	NCRP	ICRP (If Different)
Occupational Exposure:		
Stochastic effects: effective dose limits		
Cumulative	10 mSv × age	20 mSv/y averaged over 5 years
Annual	50 mSv/y	50 mSv/y
Deterministic effects: dose equivalent limits for tissues and organs (annual):		
Lens of eye	150 mSv/y	150 mSv/y
Skin, hands, and feet	500 mSv/y	500 mSv/y
Embryo/Fetus Exposure:		
Effective dose limit after pregnancy declared	0.5 mSv/month	Total of 1 mSv to abdomen surface
Public Exposure (annual):		
Effective dose limit, continuous or frequent exposure	1 mSv/y	No distinction between frequent and infrequent—1 mSv/y
Effective dose limit, infrequent exposure	5 mSv/y	
Dose equivalent limits; lens of the eye	15 mSv/y	15 mSv/y
Skin and extremities	50 mSv/y	50 mSv/y
Education and Training Exposure (annual):		
Effective dose limit	1 mSv/y	No statement
Dose equivalent limit for lens of eye	15 mSv/y	No statement
Skin and extremities	50 mSv/y	No statement
Negligible Individual Dose (annual):	0.01 mSv/y	No statement

Based on National Council on Radiation Protection and Measurements: *Recommendations on Limits for Exposure to Ionizing Radiation.* NCRP Report No. 116. Bethesda, MD; 1993; and International Commission on Radiation Protection: *Recommendations of the ICRP.* ICRP Publication 103. New York, NY: Pergamon Press; 2007.

Nuclear Exposure Safety Limity



EPT Nucleonic Density and Level Measurement

- **CONCLUSION**

  - **Advantages from the Commercial Standpoint**
    - No Atomic Energy Board Regulations
    - No End User needs Approvals/ Certification for using the Device
    - No Approvals/ Certification required for each and every device imported to India
    - No Reporting or Renwals
    - No requirement of Radiation Scientific Officers in the plant

  - **Safe from the Health and Hazard Standpoint**
    - Completely safe
    - No disposal concerns

AERB Letter

दूरभाष / TELEPHONE : 91-22-2599 0100 / 0101
फैक्स / FAX : 91-22-2599 0650, 2558 3230
वेबसाइट / WEBSITE : www.aerb.gov.in

नियामक भवन / NIYAMAK BHAVAN,
अणुशक्तिनगर / ANUSHAKTINAGAR,
मुंबई / MUMBAI-400 094.

ISO 9001:2008

सत्यमेव जयते

भारत सरकार
GOVERNMENT OF INDIA
परमाणु ऊर्जा नियामक परिषद
ATOMIC ENERGY REGULATORY BOARD

RADIOLOGICAL SAFETY DIVISION

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Head, Industrial Applications, Transport and
Waste Management Section

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Fax. No. 25990650
dashsharma@aerb.gov.in

Ref: AERB/RSD/TRCPG/CP/Adv/2016/2833

August 22, 2016
23

Sub: No Objection Certificate for import of radioactive material

This has reference to your letter No. EIP/RG/AERB/16/505/ dated 20/08/2016, regarding the issuance of no objection certificate for the import of radioactive material as mentioned below:

Radioisotope	:	Na-22
Activity in each device	:	0.7 MBq
Make	:	EPT Ltd., Russia
Model	:	IPB-1K
Quantity	:	04 Nos.
Validity	:	One year from the date of issue of this letter

In exercise of powers conferred under section 16 of the Atomic Energy Act, 1962 read in conjunction with Rule 3 of the Atomic Energy (Radiation Protection) Rules, 2004, promulgated under the said Act, the Atomic Energy Regulatory Board (AERB) has no objection from radiological safety stand point to the import of the above-specified radioactive material by you. This NOC is subject to the following conditions:

Even though the end users of the aforementioned equipment are not required to obtain consent from AERB; however, M/s EIP Enviro Level Controls Pvt. Ltd., Noida-201 301, shall submit periodic reports, in the months of January and July every year, to AERB with the following:

(a) The number of units supplied and installed with contact details of the buyers.
(b) Servicing and maintenance details highlighting the major problems, if any.

22/8/16

(P.K. Dash Sharma)

Queries Still Pending

- Why is the device being discussed by only one company. What is the patent/ algorithm :
  - **HIGH RESOLUTION DETECTOR : Works with even smallest of radioactivity**

- Then **Why only Na-22** as a source and no other isotope
  - **Na is a natural element in the body and excreted** through urine, perspiration and sweating
  - Hence, Na-22 is excreted fully from the body and never stays inside to cause any damage

Some Technical Parameters of the device

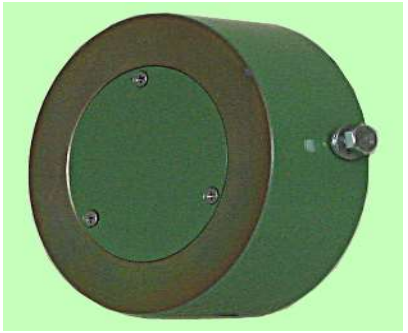
Range of measured density, kg/m3	From 300 to 2500
Outer pipe diameter, m	From 0,05 to 0,7
The limit of the absolute error, kg/m3	From 6 to 20
Standart current output	0-5 mA or 4-20 mA
Digital indication on a front panel of data processing block	
Power consumption, W	Not more than 10
Range of working temperatures, ºC	
- for a detection block	from – 40 up to + 70
-for a block of data handling	from 0 up to +50
Versions of detection blocks: •hermetically sealed •explosion proof (PB ExdI/IExdIICT6) •Mechanical protection - IP65	

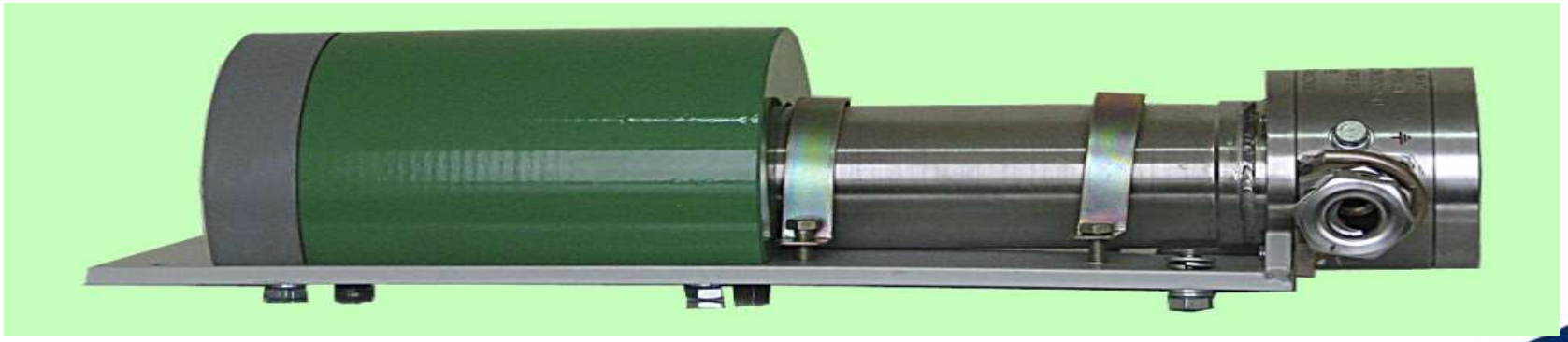
Applications

Radioisotope methods of control are generally essential in extremely tough operating environnent

1. toxic, aggressive and biologically hazard materials;
2. corrosive and abrasive substances;
3. molten and cryogenic materials;
4. radioactive substances with high or/and alternative activity;
5. foams, slurries and sludge;
6. powder and other high suspended solids;
7. pulp, ore and other dry bulk materials;
8. vessels without pressure restrictions;
9. vessels without temperature restrictions
10. In the conditions of buildup of the controlled media to the sides and constructions of the process tank
11. opacity, the presence of vapor or mist above the controlled level.

Instrument Images





Installation Images

PRODUCT SILOS

REAL TIME INVENTORY MEASUREMENT

Product Silos/ Warehouses

Need for Inventory Measurement

- Measure the Urea/ NPK Fertilizer Stocks at all time
- Identify the ullage
- Allocation of different products
- **Plan inventory**
  - **Reduce the Safety Stock requirements**
  - **Increase the inventory turn overs for the same yearly requirement**
    - Reduces Inventory Carrying Cost
    - Reduces cash invested in Inventory

How increase in accuracy leads to effective planning

- Example
  - 100 million tons of urea used from a warehouse/ product silo each year
  - Inventory turn over is 4 times, means at a time 25 million tons is stored and gets rotated 4 times in a year
  - Cash is blocked in 25 million tons stocked and the inventory carrying cost of 25 million tons of urea
  - If accurate inventory planning, the inventory turnover can be made 5 times, meaning at a time 20 million tons is stored and gets rotated 8 times in a year
  - Cash is blocked in only 20 million tons stocked and the inventory carrying cost of of only 20 million tons of urea

All this is only possible by having an
ACCURATE INVENTORY MEASUREMENT IN PLACE

How increase in accuracy leads to effective planning

- Example

Total Urea Sold in a year

Average Inventory at any Point in Time
is 25 Mil. Tons

Inventory Turnover
is 100/25 = 4 Times in a Year

ASSOCIATED COST

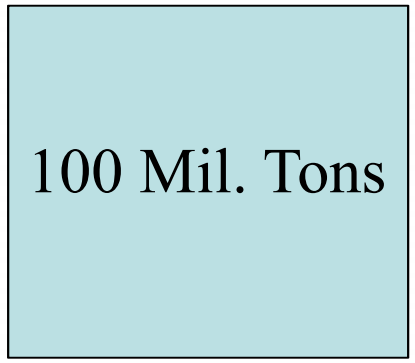
- Inventory Cost Hold Up = 25 x Rs. 1 Crore = Rs. 25 Crores
  (if 1 Mil. Ton Urea is Rs. 1 Crore)

- Inventory Carrying Cost = .25 x Rs 25 Crores = Rs. 6.25 Crores
  (if Inventory Carrying Cost is 25%)

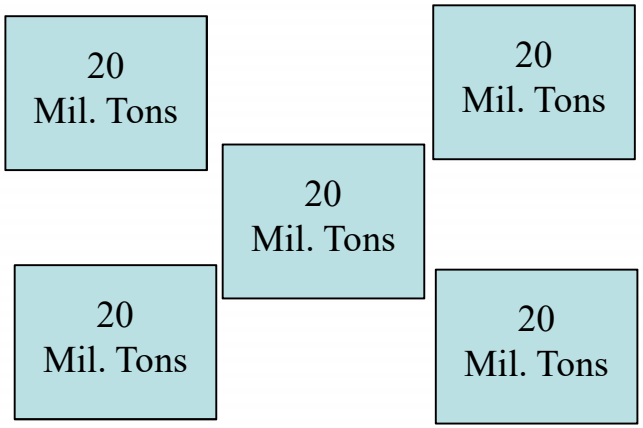
How increase in accuracy leads to effective planning

- Example

If we make Inventory Turnover
= 5 Times in a Year,
Then Average Inventory required is
100/5 = 20 Mil. Tones



Total Urea Sold in a year



Average Inventory at any Point in Time
is 20 Mil. Tons

ASSOCIATED COST

- Inventory Cost Hold Up = 20 x Rs. 1 Crore = Rs. 20 Crores
  (if 1 Mil. Ton Urea is Rs. 1 Crore)

- Inventory Carrying Cost = .25 x Rs 20 Crores = Rs. 5 Crores
  (if Inventory Carrying Cost is 25%)

How increase in accuracy leads to effective planning

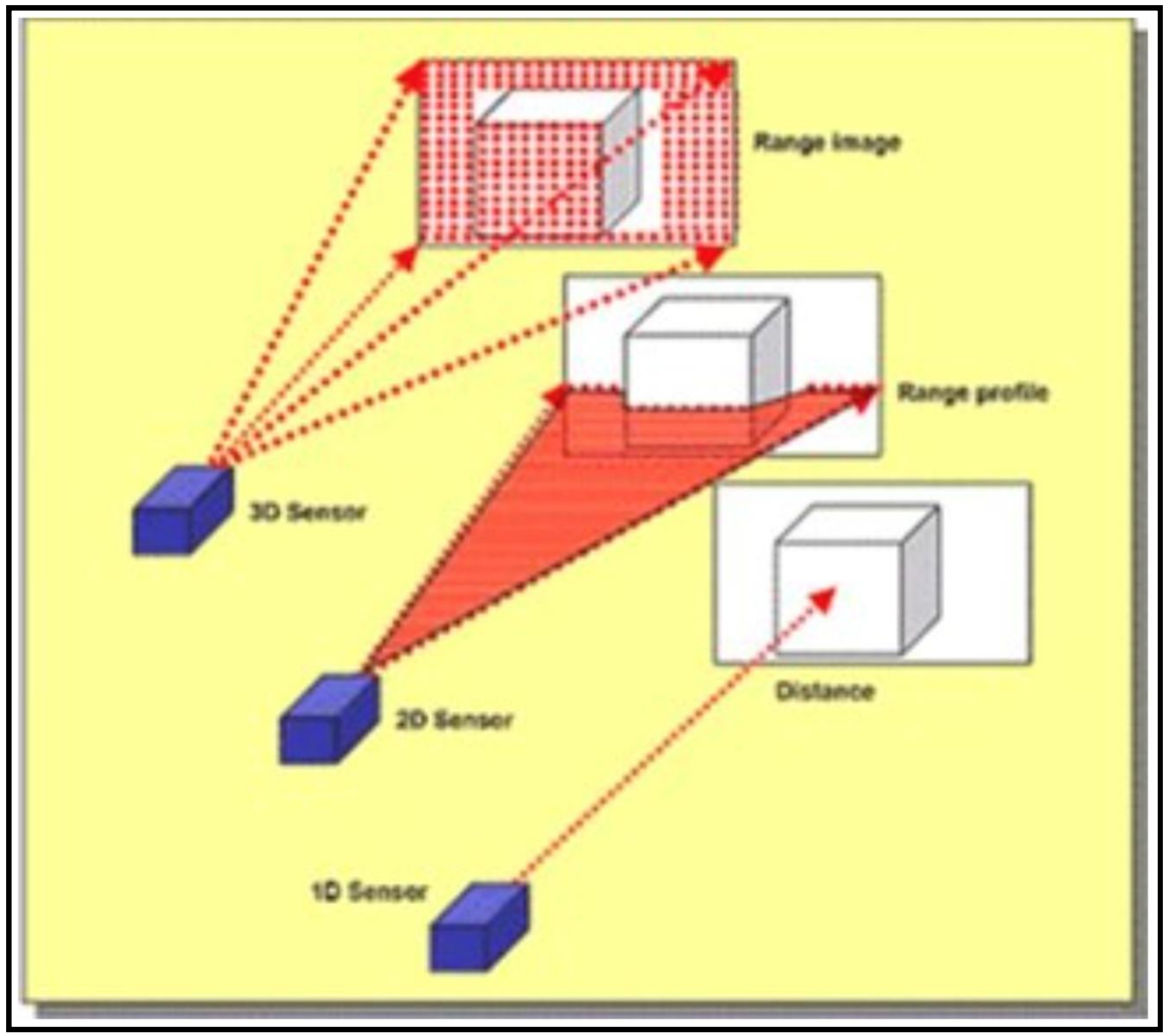
- Example
  - Total Cost with 4 Inventory Turnovers is Rs. 31.25 Crores
  - Total Cost with 5 Inventory Turnovers is Rs. 25 Crores
  - Total Savings is Rs. 6.25 Crores

All this is possible only by having an ACCURATE INVENTORY MEASUREMENT IN PLACE

Drawback of Raw In and Out Calculations

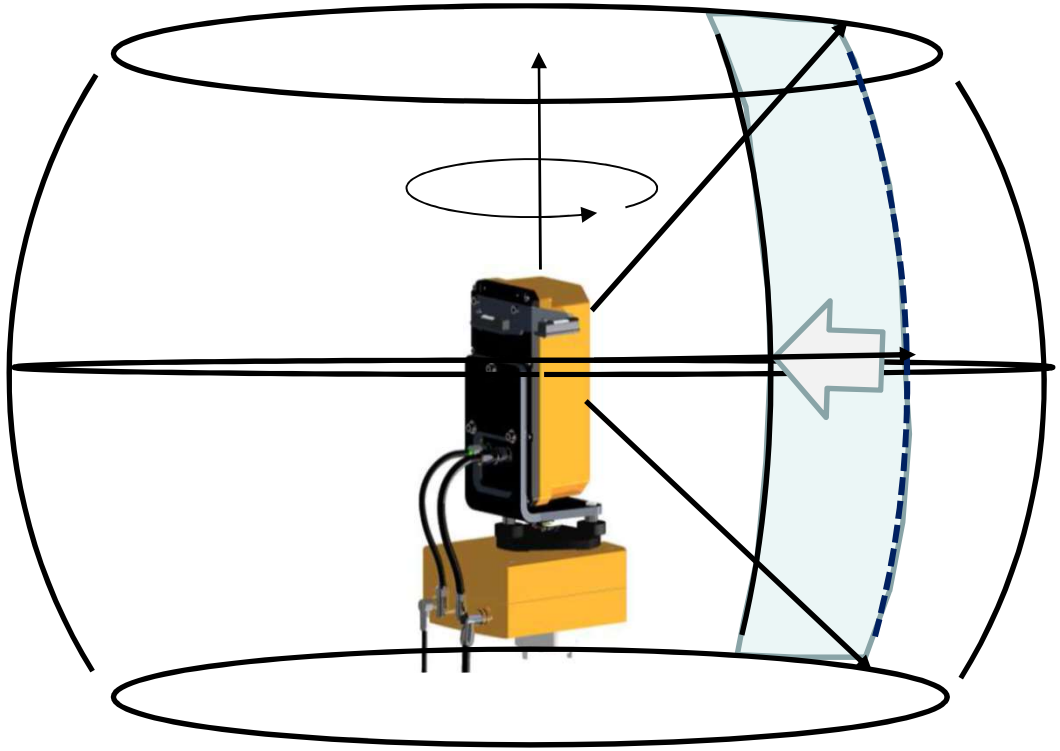
- Fertilizer Product brought in and out of a product silo are measured
- However, the quantity is small and that measurement has its own inaccuracies
- Those inaccuracies accumulate over time without an exact estimate as the Silo/ Warehouse does not get empty for a long period of time
- Hence : A REAL TIME INVENTORY MEASUREMENT IS REQUIRED TO GIVE BETTER PICTURE OF THE INVENTORY

3D Laser for Inventory Planning



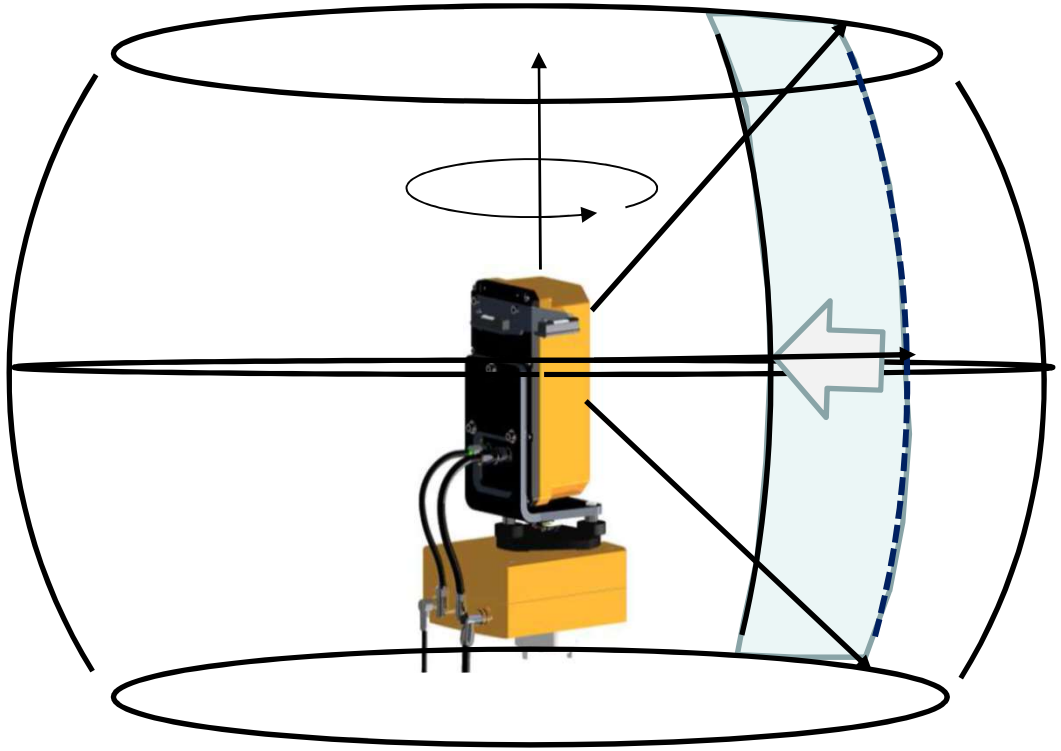
3D Laser for Inventory Planning

3D Laser Scanner Moves 360 Degrees to Scan the whole Pile



3D Laser for Inventory Planning

Can be mounted on a moving tripper to take measurement with only 1 Scanner for the complete warehouse



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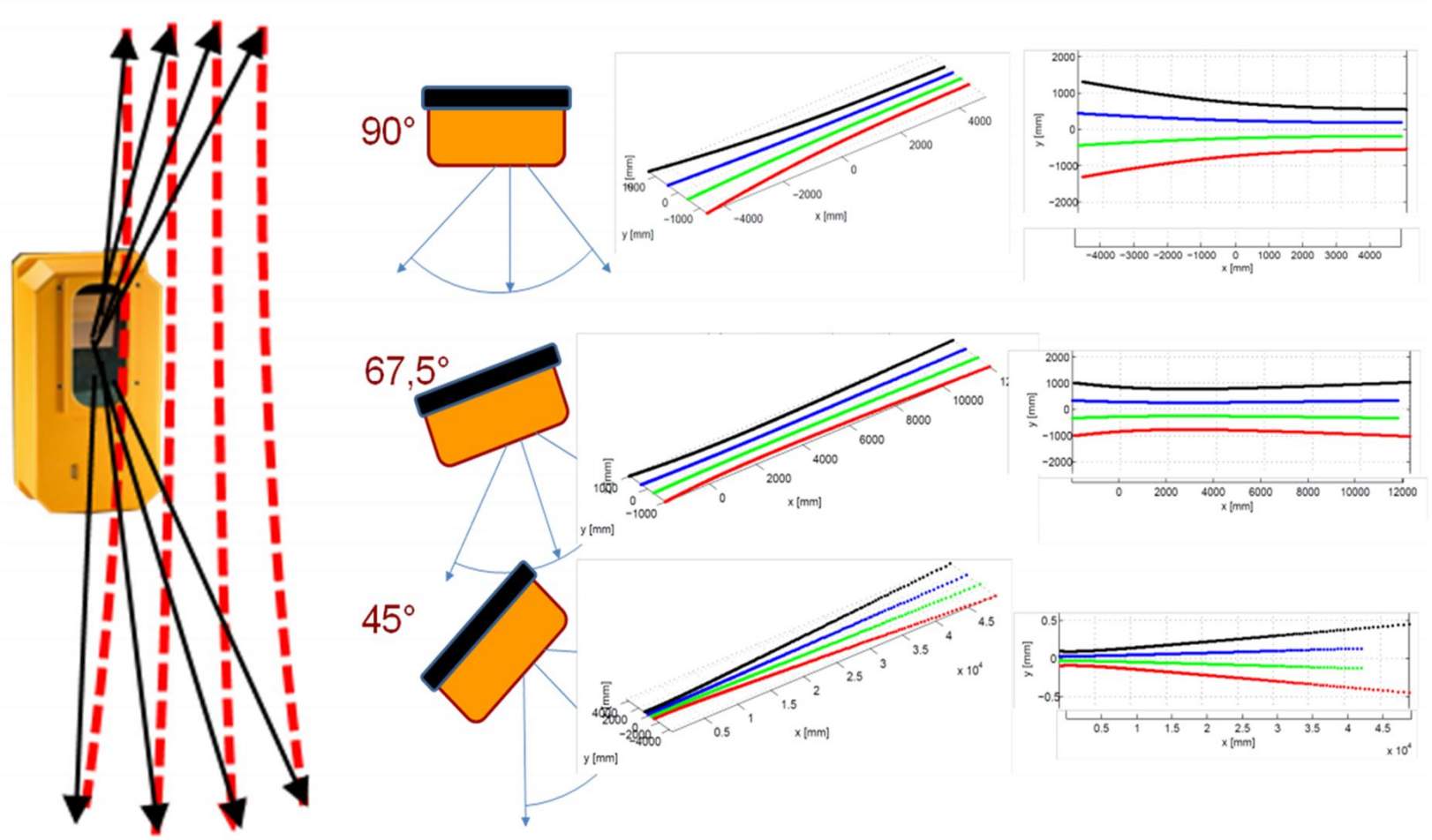

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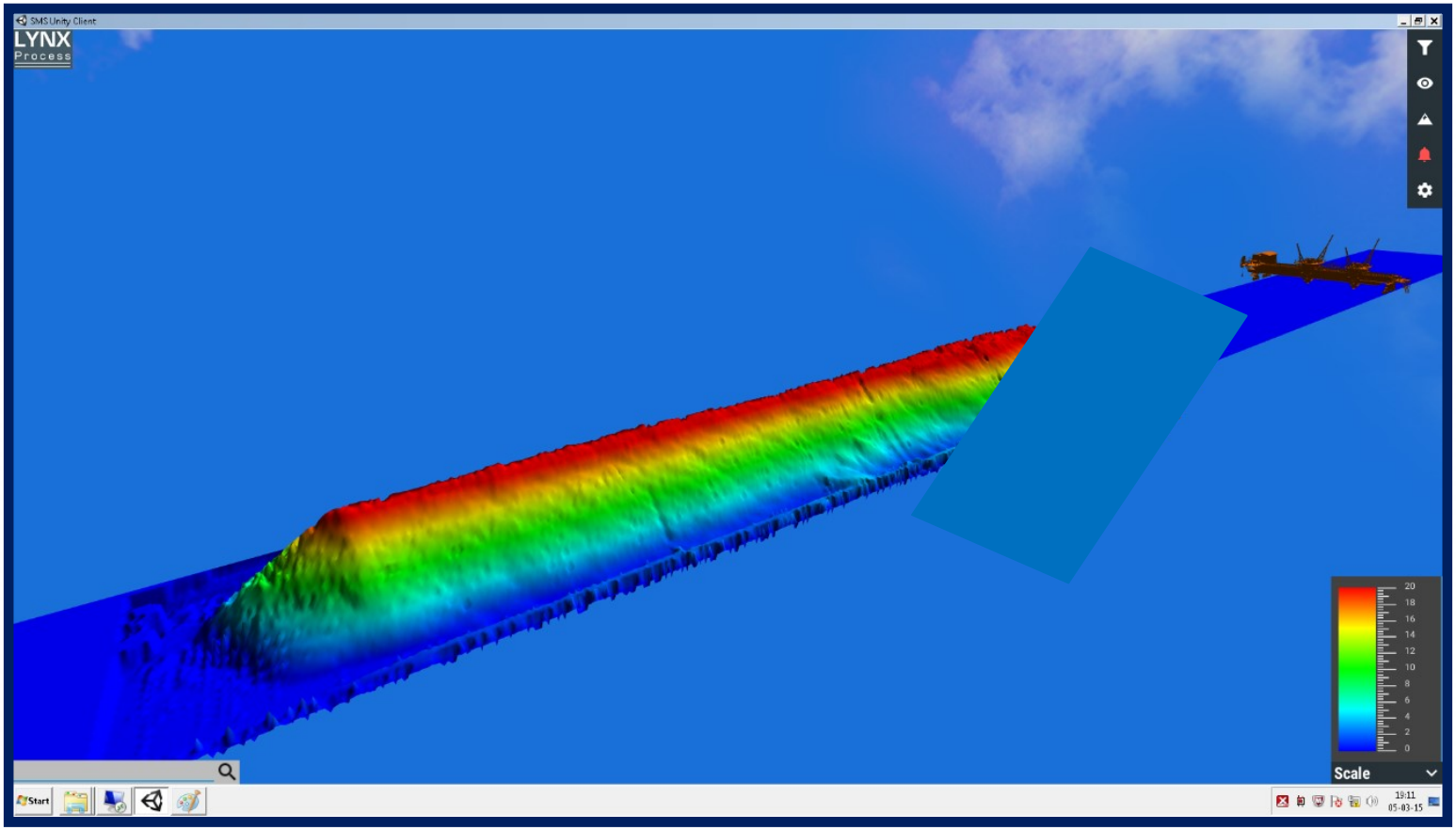


Thank you for listening!