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Working with ARPANSA to Improve Compliance Standards Neutron Moisture Meters (Soil Moisture Probes)

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Soil Moisture Probes

- Uses

- Agronomy research and extension
- Environment research and monitoring
- Commercial land management
- Irrigation scheduling
- Consulting services

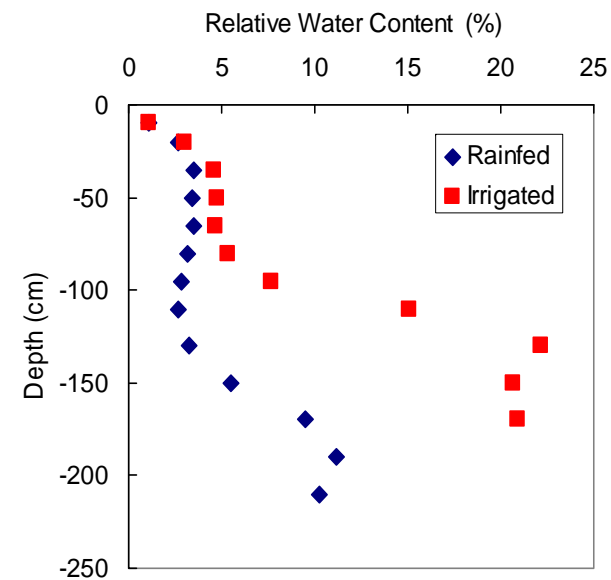
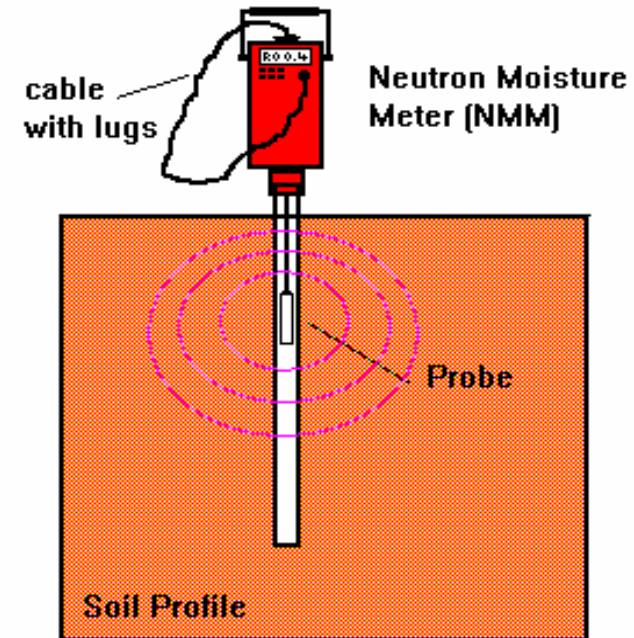
- Used in CSIRO by a number of research divisions

- CSIRO Forest Biosciences
- CSIRO Plant Industry
- CSIRO Land and Water



Operating Principles

- A probe containing a 1.85 GBq Am241/Be source is lowered to defined depths within a soil profile.
- The source releases a known density of “fast neutrons” (9,600 kilometres per second).
- The “fast neutrons” collide with atoms within the soil (in particular hydrogen in water) and lose speed and become “slow neutrons” (3 kilometres per second).
- A detector within the probe measures the density of the cloud of “slow neutrons” surrounding the probe.
- If the soil is dry, the cloud of neutrons will extend further from the probe and be less dense.
- If the soil is wet, the cloud of neutrons extends only a shorter distance from the probe and is more dense.



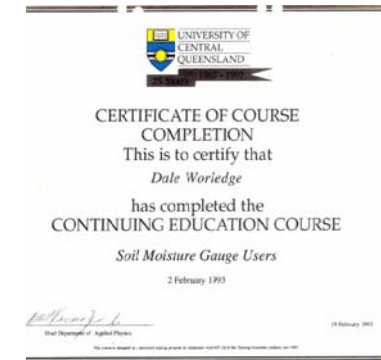
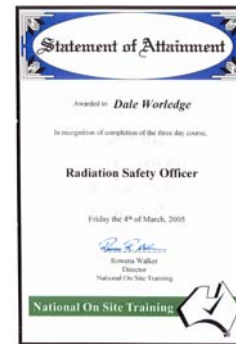
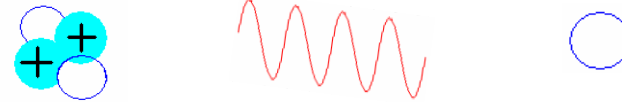
Hazards and Control Measures

- Hazards

- Radiation Source – Alpha Particles, Gamma and Neutrons

- Controls Measures

- Inventory
- Training
- Operating Procedures
- Storage and Transport
- Labelling
- Personal Monitoring
- **Radiation Survey Meter**
- **Recommended Working Life**
- **Wipe/Leak Testing**



Survey Meters

- Compliance Requirements

- Radiation Protection Series No 5 – Section C2.1

“Radiation survey meters must have an operational and calibration check at intervals not exceeding 12 months.”

- CSIRO History

- Low compliance – survey meters either not used at regular intervals or sub-standard record keeping of survey results
- Confusion about calibration interval – 12 months or 5 years.

- Future

- Improved meters
- Regular calibration testing
- Improved record keeping



Recommended Working Life (RWL)

- **Equipment – CPN Moisture Meter**
 - Long operational histories
 - No reported loss of containment
 - CPN Probe - RWL @ 40 years
 - Most likely reason for major service or disposal – faulty electronics
- **Source — Double Encapsulated Am/Be**
 - Manufacturers – RWL @ 15 years
 - CSIRO – many probes > 15 years old
 - ARPANSA Ruling - need prior approval to continue use of Group 2 sources beyond RWL – initial guidelines called for leak testing.
- **Issues**
 - Leak Testing – difficult, expensive and with an increased exposure risk
 - Transport difficulties – CSIRO need to transport probes
 - Local supplier – currently unwilling to upgrade electronics while source is in probe – potential return to USA
- **Outcomes**
 - Need workable procedure that ensures safety
 - Agreement with ARPANSA - increased frequency of wipe testing for sources between 1 and 2 RWL



Wipe Testing

- Compliance Requirements

- Radiation Protection Series No 5 – Section 3.2.7

“..the responsible person must ensure that wipe tests of the source(s) and source assembly are carried out in a manner approved and at a time specified by the relevant regulatory authority”

- AS 2243.3 - Section 6.64

“..the RPA should arrange for each sealed source or its housing to be examined for contamination and for the integrity of its sealing ie. By wipe testing or smear testing each source or its housing at annual intervals.”

- CSIRO History

- Low compliance
- Failure to complete wipe tests altogether or time period between wipe tests was often >12 months.

Options for Wipe Testing

- External

- Independent expert
- Total compliance audit – storage, labelling, working protocols, wipe testing etc
- Expensive – remote sites may cost in the order of \$2,000

- Internal

- Network of trained personnel – Site/Divisional Radiation Safety Officers
- Standardised protocol – agreement between ARPANSA and CSIRO
- Inexpensive
- Analysis of wipe tests
 - External – sample can be delivered by post – relatively inexpensive
 - Internal – CLW reviewing option for analysing wipe tests – equipment available – may impact on research capabilities



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