ALARA in Radiography

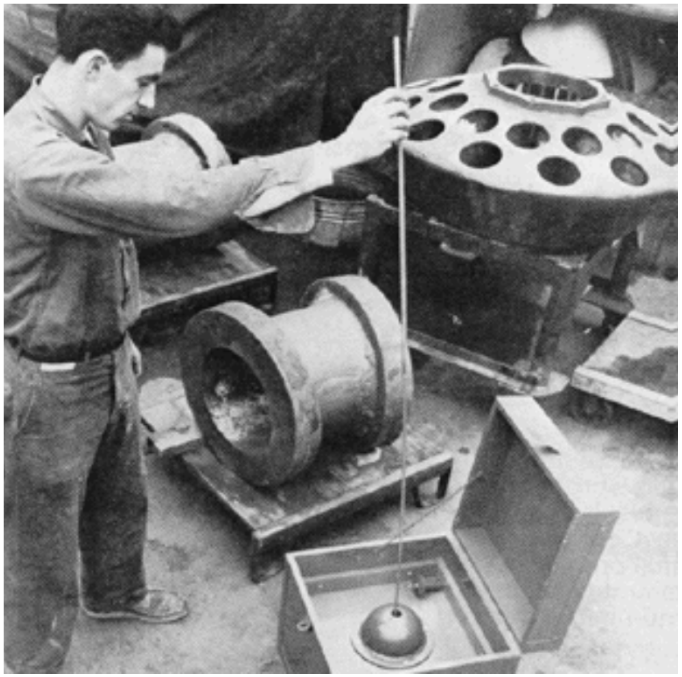
Michael Fuller

on behalf of the

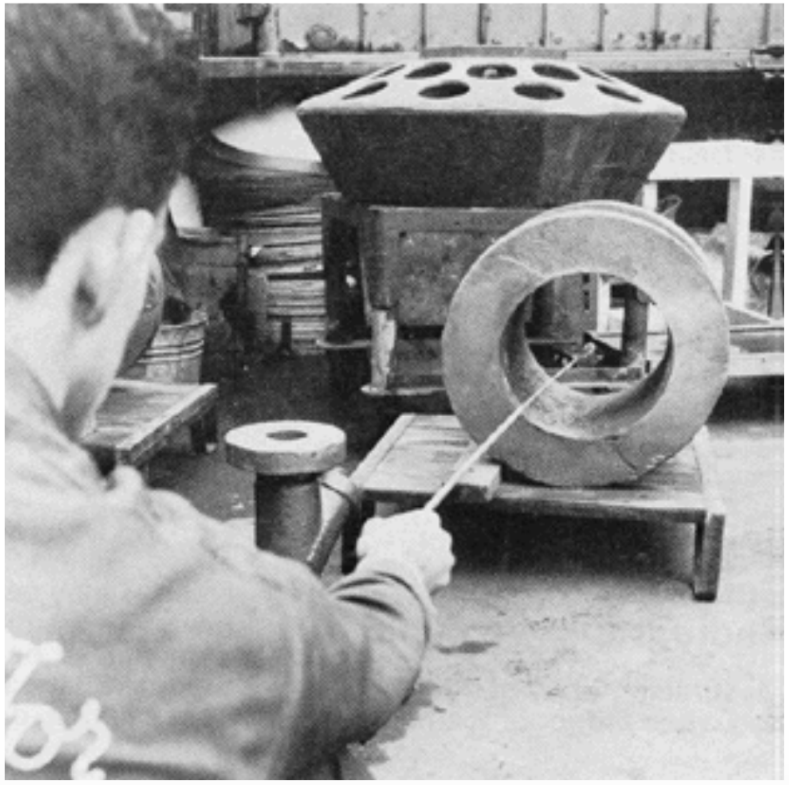
International Source Suppliers and Producers Association (ISSPA)

In the Beginning

Ra-226



“Fish Pole” Technique



Time – Distance – Shielding

Distance

10 meters (user to projector)

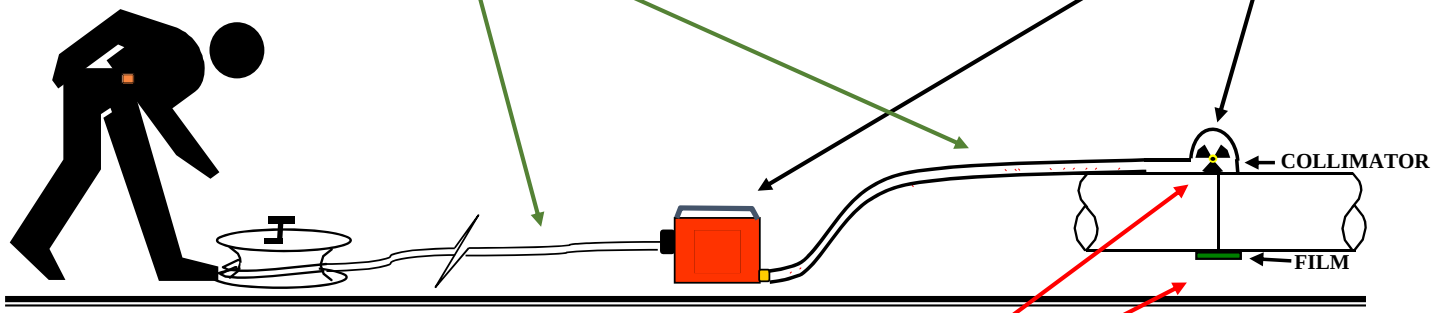
7 meters (projector to exposure point)

Shielding

Depleted Uranium (DU)

Tungsten, Lead

Use of bunkers



Time

High Activity Sealed Source (HASS)

Film optimization

Many Flavors

Source Styles

Isotope Use

Isotope	Half Life	Gamma Energy Range	Approximate Steel Working Thickness	Gamma Constant R/h (mSv/h) per Ci @ 1 meter	Half Value Layer of Lead cm (in)
Co-60	5.27y	1.17 and 1.33 MeV	50 - 150 mm	1.368 (13.68)	1.27 (0.5)
Ir-192	74d	206 - 612 keV	12 - 63 mm	0.591 (5.91)	0.51 (0.2)
Se-75	120d	97 - 401 keV	3 - 29 mm	0.826 (8.26)	0.1 (0.039)
Yb-169	32d	63 - 308 keV	2 - 20 mm	0.327 (3.27)	0.08 (0.032)
Cs-137	30y	662 keV	12 - 63 mm	0.376 (3.76)	0.64 (0.25)
Tm-170	129d	52 - 84 keV	2 - 15 mm	0.006 (0.06)	0.61 (0.24)

Isotope Use – Example: ^{60}Cobalt

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Selenium 75 Benefits / Drawbacks

Benefits

- Lower energy – easier to shield
- Softer gamma spectrum – better image quality
- Lower gamma constant – reduced exclusion zone size
- Longer half-life than Ir-192

Drawbacks

- Lower energy – less penetration
- Elemental selenium highly volatile
- More expensive than Ir-192

SCAR Technology

SCAR = Small Controlled Area Radiography

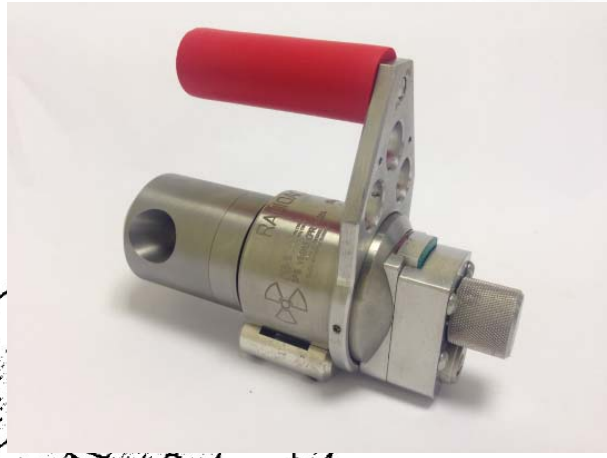
also marketed as

SAFER (Small Area for Exposure Radiography)

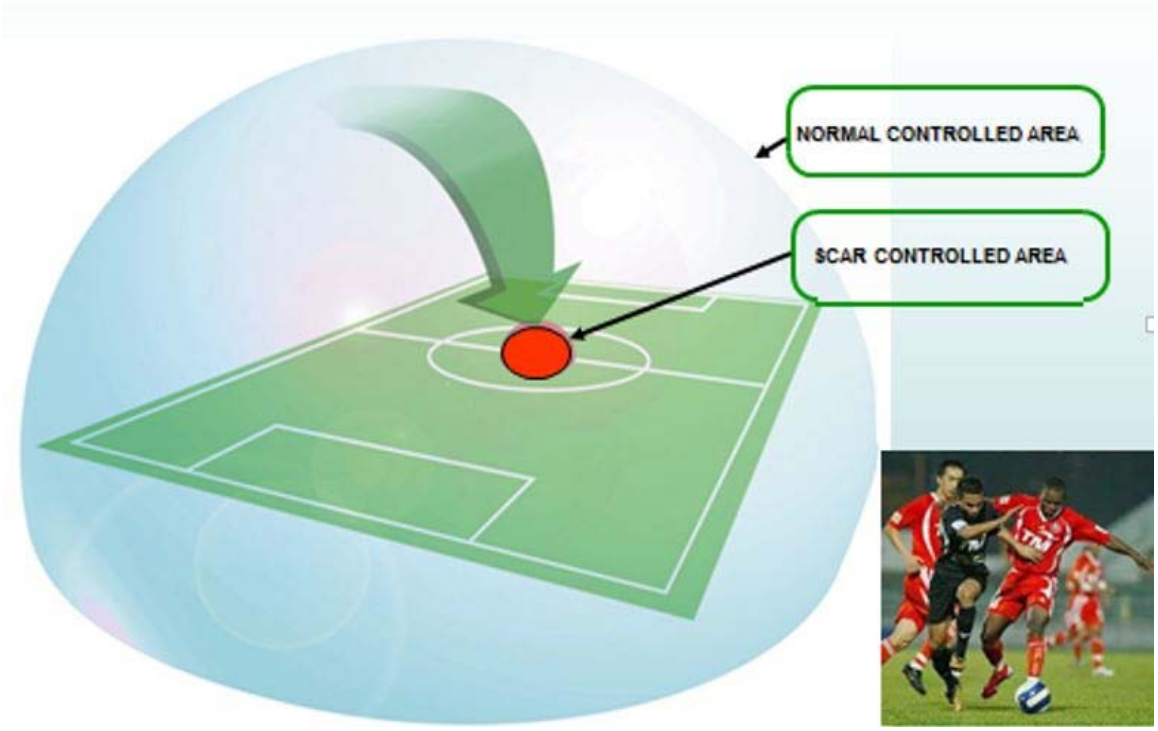
or

Close Proximity Radiography

Close Proximity / SCAR Not New



Close Proximity / SCAR Benefits



20 mSv/h boundary for 100 Ci Ir-192 source ≈ 150 meters

Design Inputs

Regulatory

Operational Safety

Industry Events

Manufacturing Costs

National / International Standards

Transportation Safety

Customer Input

Available Technology

Conflicting Desires

User Device needs to be as light as a feather	≠	**Regulator** Loaded device should have zero radiation leakage
Regulator No Depleted Uranium	≠	**Manufacturer** DU offers best shielding
User Simple to operate	≠	**Regulator** Foolproof

Conflicting Desires

U.S. User Higher activity sources mean shorter exposure times	≠	**Some non-U.S. Users** Cannot use sources above XX curies
User Source and/or device needs to last forever	≠	**Physics** Everything has a finite operational life
User Free	≠	**Manufacturer** How much money do you have?

Product Adoption

- Can the product be priced to recover development costs, manufacturing costs, and at the same time be enticing to buyers?
- Will the customers require a new license or change to existing license?
- Will the new product require significant training for the customer?
- Will the new product change traditional radiography methods or results?
- Will the new product obsolete existing accessories?
- Will the new product a provide a marked improvement (operational, compliance)?

ALARA Implementation

Exposure ALARA is primarily dictated through regulatory requirements.

Designs developed with many inputs, including regulatory.

SCAR technology seeing some adoption.

Selenium-75 use is on the rise.

Training and incorporation of a safety culture