

Self-indicating

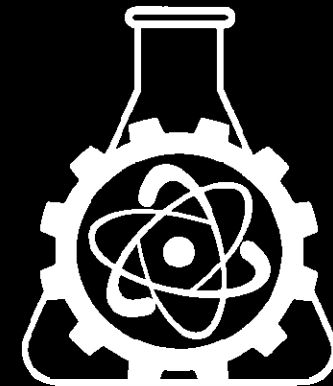
Intant

Radiation

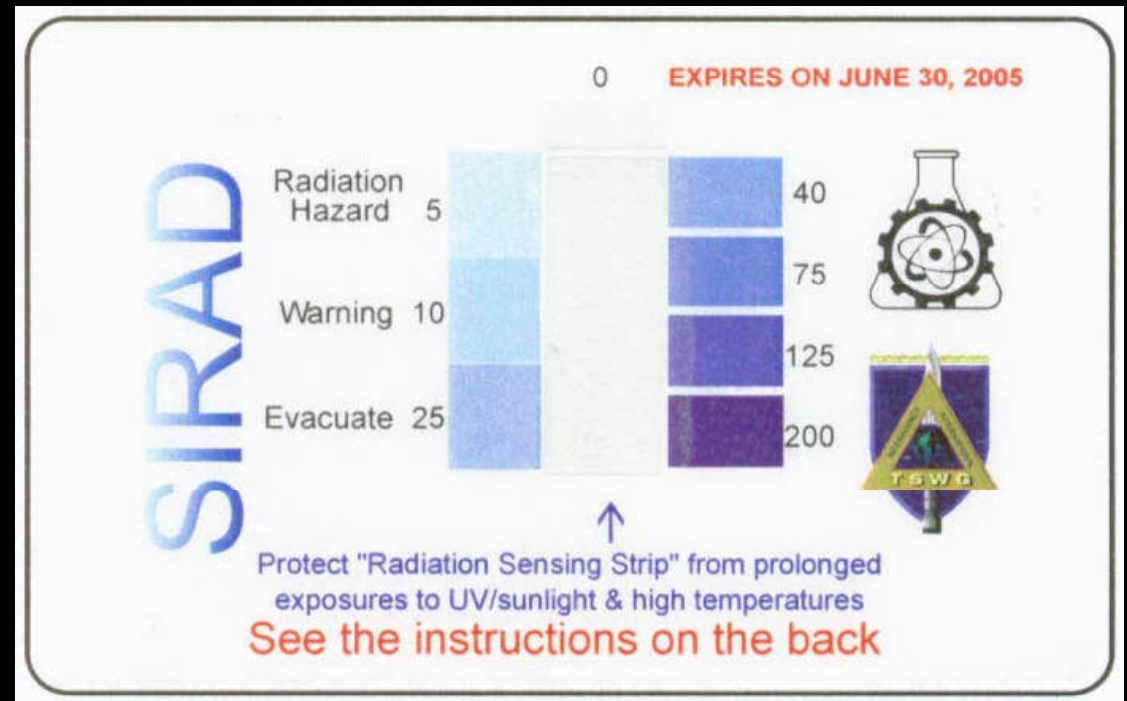
Alert

Dosimeters

(SIRAD[®])



INNOVATION IS OUR BUSINESS

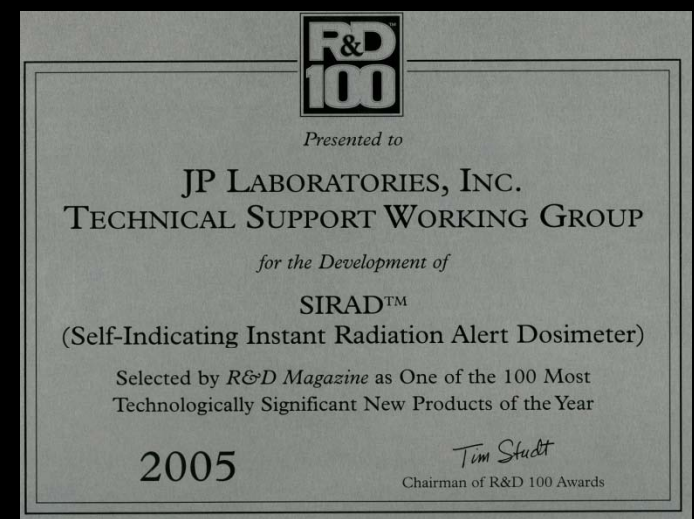
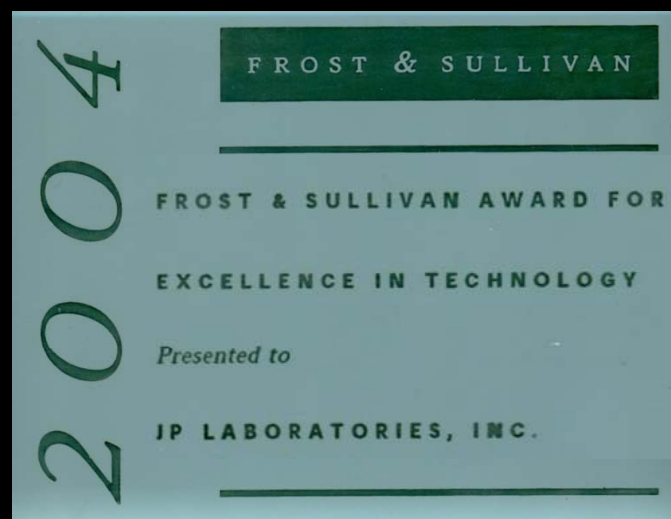


A FAMILY OF SMART CASUALTY DOSIMETERS



SIRAD® TECHNOLOGY AN ULTIMATE IN CASUALTY DOSIMETRY

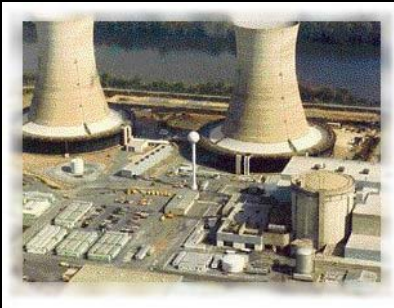
AN AWARD WINNING TECHNOLOGY
PIONEERED BY
Gordhan Patel/JP Laboratories, Inc



**RADIOLOGICAL
INCIDENTS
(e.g., DIRTY BOMB)
&
NEED FOR SIRAD®**

RADIOLOGICAL INCIDENTS CAN OCCUR AT

- Nuclear power plants
- Radioactive materials/waste storage facilities
- Nuclear submarines
- Radiation processing and treatment facilities (hospitals)
- Nuclear processing facilities
- Nuclear bombs detonation
- Dirty bombs/Radiological Dispersion Devices (RDD) detonation



MAJOR OBJECTIVES OF A DIRTY BOMB

- Make property uninhabitable
- Generate widespread panic as those in the affected area fear radiation exposure
- Make people worry about the exposure and cancer
- Cause massive disruption of our lives



Scientific American, November 2002: A simulated detonation of radioactive cesium-137 (3,500 curies, ~50 grams) dirty bomb at the lower tip of Manhattan Island.

TERROR WEAPONS & THEIR EFFECTS

Weapon	Availability	People killed	Property Damage	Duration
Explosive	Easy	Yes/Many	Yes/Large	Shortest
Chemical	Difficult	Yes/Many	No	Short
Biological	Difficult	Yes/Many	No	Short
Dirty Bomb	Very difficult	Few but panic & life time worry	Huge	Longest
Nuclear	Almost impossible	Huge number	Huge	Long

CHEMICAL Vs RADIOLOGICAL ACCIDENTS

- **BHOPAL, INDIA**
(Worst chemical accident, surrounding area re-inhabited in days for ever)
- **CHERNOBYL, UKRAINE**
May never be re-inhabited



RADIATION

AND

HUMAN HEALTH

RADIATION EXPOSURES

- Chest X-ray 0.03 rad
- Natural background 0.25 rad/year
- Gastric fluoroscopy 0.4 rad
- CT (head and body) 1.1 rad

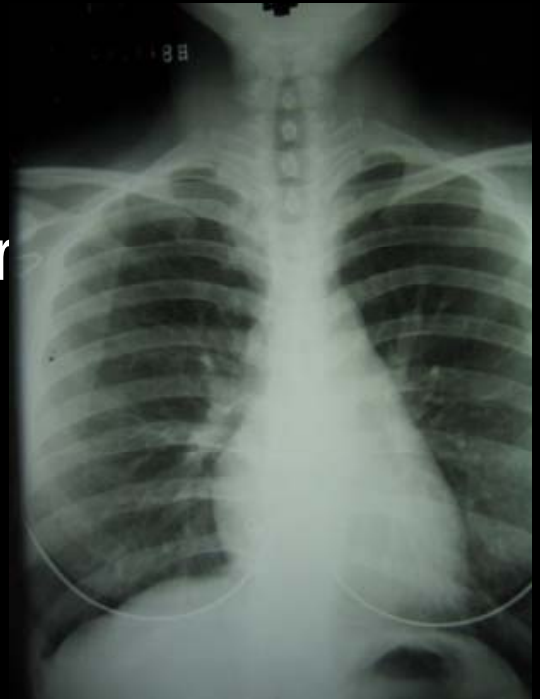
1 rad = 0.01 Gy (Gray),

1 rad = 0.01 Sv (Sievert)*

1 rad = 1 rem*

1 Sv = 100 rem

* 1 rad = 1 rem/10 mSv
(for tissue equivalent materials)



ACCEPTABLE RADIATION EXPOSURES

- **NRC Guidelines for Radiation workers**
 - **5 rads:** Yearly limit, **25 rads:** Life time limit
- **EPA Guidelines for Emergency workers (once-in-a-lifetime event)**
 - **25 rads:** For voluntary maximum radiation dose to emergency workers for non-life saving work during a reactor emergency.
 - **75 rads:** For maximum radiation dose to emergency workers volunteering for life saving work.

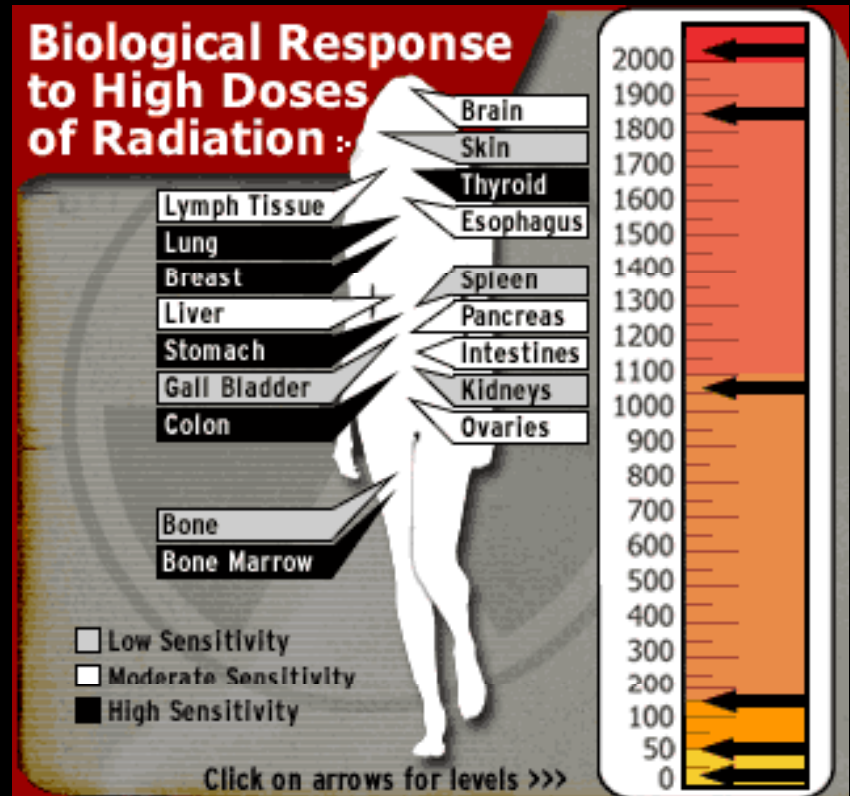
NRC: US Nuclear regulatory commission

EPA: US Environmental Protection Agency

Dose limits are much lower for fetus (0.5 rad) and children

ACUTE RADIATION EXPOSURE

- 0-25 rads:** No observable effect
- 25-100 rads:** Slight blood changes
- 100-200 rads:** Significant reduction in blood platelets and white blood cells (temporary)
- 200-500 rads:** Severe blood damage, nausea, hair loss, hemorrhage, death in many cases
- >600:** Death in less than two months for over 80%



Some body parts, e.g., bone marrow and thyroid are more sensitive than others, e.g., bones and liver.

**PANIC, WORRY
AND
ACCIDENTS**

**An
example
of what a
panic
Can do!!!**



31 August 2005: Stampede in Baghdad Killed Over 800 Shiite Pilgrims



WORRY

- Most experts agree that in the event of a dirty bomb attack, the greatest number of casualties would result from panic and worry.



IN THE EVENT OF A DIRTY BOMB DETONATION

How to Minimize Panic and Concern?

- Educate public about radiation and its effects
- Provide radiation dosimeters capable of monitoring harmful dose before an attack
- If they know they received...
 - Very low dose (e.g., below 1 rad): It is less likely widespread panic would occur (vast majority would get below 1 rad)
 - 5-25 Rads: They will be worried, however, only a tiny fraction may get above 5 rads
 - Above 25 rads: They will be treated first (least likely anybody would get above 25 rads)

HOW TO MINIMIZE THE PANIC

- When exposed to radiation from a "dirty bomb" or nuclear detonation, the sensor of SIRAD develops blue color instantly and the color intensifies as the dose increases, providing the wearer, first responders and medical personnel instantaneous information on cumulative radiation exposure of the victim.
- People who have not received high dose will not rush to hospitals. This will minimize the panic and people who received high dose will be treated first. It can take days to get that information by other methods. SIRAD is affordable (~\$2 - \$20).

WOULD HIGHLY SENSITIVE RADIATION DEVICES CAUSE MORE PANIC AND WORRY?

- It is likely that highly sensitive electronic detectors may cause more worry and panic for users because:
 - Alarms will sound slightly above the natural background radiation
 - People may get over concerned
 - They may make many worry and panic, which may cause accidents and casualty

TYPE OF DOSIMETER NEEDED

- Instant, Self-indicating (color developing)
- User friendly, Affordable
- Light weight, Wearable
- Always ready without a power source
- Service life of at least one year
- Practically non-destructible
- Capable of monitoring harmful high dose 5 -1,000 rads

**SIRAD[®] FAMILY OF DOSIMETERS HAVE THESE
AND OTHER DESIRABLE PROPERTIES**

NEED FOR SIRAD DOSIMETERS

- People and governments around the world are concerned about terrorist attacks using a dirty bomb. When detonated, such a device could cause wide spread panic, massive disruption and render the surrounding area uninhabitable for years. Property damage could be in billions, even in trillions and make millions worried for the rest of their lives about their radiation exposure. A problem with radiation is that it can't be seen, smelled or felt and its effect (e.g., cancer) can appear after years. Hence, affected people want to know their radiation exposure immediately, *“Did I receive a lethal exposure to ionizing radiation, will I be OK or will I develop cancer in future?”*.

NEED FOR SIRAD DOSIMETERS

- First responders (police, firefighters, medical personnel, etc.) need to quickly assess radiation exposure among the affected to ensure that treatment is first provided to those who need it the most. SIRAD[®] (Self-Indicating Intant Radiation Alert Dosimeter) family of dosimeters answer those questions quickly and cheaply. They are personal smart casualty dosimeters that reliably monitor radiation exposure in the event of a radiological terrorist attack or an accident at a nuclear power plant. The user-friendly SIRADs are designed to be carried with you at all times - in a wallet, purse, or on your driver license or identification badge at work.

NEED FOR SIRAD DOSIMETERS

- These affordable (\$2-\$30 depending upon the type & quantity) dosimeters in form a badge or sticker work without the need for batteries, calibration, or maintenance. When exposed to radiation, the sensor of SIRAD develops blue color instantly and the color intensifies as the dose increases (see the photos on the following slide). Thus, it provides the wearer and medical personnel instantaneous information on cumulative radiation exposure of the victim. The exposure can be estimated simply by matching the colors of the sensor with the adjacent color reference bars. It can take days to get that information by other methods which are also expensive (\$100-300).

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

0 rad

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

0 rad

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

10 rads

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

10 rads

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

100 rads

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100 rads

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

2 rads

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

2 rads

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

25 rads

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

25 rads

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

200 rads

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

200 rads

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

5 rads

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

5 rads

Lift the orange cover to estimate the dose more accurately when needed. Estimate the radiation exposure by matching the color of the sensor with numbered bars. Avoid prolonged exposure to sunlight & heat. Made 02/08

50 rads

Expires (1) one year from the issue date or (2) when the color of the area surrounding the central dot of the FIT indicator matches bar on the right. The dose calibration is invalid if the central dot of the FIT indicator is red.

50 rads

EFFECT OF DOSE
 RADTriage-FIT radiated
 at different dosages of
 100 KeV X-ray (red
 filter folded back)

NEED FOR SIRAD DOSIMETERS

- If people carry a SIRAD, they would know their radiation exposure at all time. If during or after the incident, the color of sensor has not changed, the wearer has not received radiation exposure large enough to cause acute medical effects and therefore has *peace of mind*. If the sensor develops color equivalent to less than 5 rads (yearly allowed limit for occupation workers), in this case, further exposure should be avoided. If the sensor has developed a darker color equivalent to 25 rads (life time allowed dose for the occupational workers) the user should seek a medical evaluation.

NEED FOR SIRAD DOSIMETERS

- If the exposure is higher than 50 rads, the person should get immediate medical treatment depending upon the dose. At exposure of 1,000 rads almost 100% of the people will die if no medical treatment is given immediately. The exposure indicated on the SIRADs can be used by medical personnel to prioritize and guide medical treatment. If false positives or negatives occur due to abnormal use, the user can monitor them with the multi-purpose FIT™ Indicator on RADTriage-FIT which also indicates when to replace your badge. Thus, SIRADs can minimize the panic, worry and triage the information.

SIRAD FILLS TECHNOLOGICAL GAP

- There was a need for a user friendly, inexpensive, light weight, wearable, instant, self-indicating, always ready without a power source, service life of at least one year and practically non-destructible dosimeter for monitoring harmful high dose (from legally allowed limits (5 and 25 rads) to almost certain mortality (1,000 rads). Such a dosimeter was not available. SIRAD fills that gap. In an event of nuclear/dirty bomb explosion or any radiological accident, SIRAD has almost all desired properties for instantly monitoring harmful high dose (1 – 1,000 rads) and thereby minimizing the panic, worry and strain on the healthcare system.