NRRPT

The NRRPT NEWS

OFFICIAL NEWSLETTER of the *National Registry of Radiation Protection Technologists*

August 2018 Incorporated April 12, 1976

Message from the Executive Secretary

Look who I found at the NEI RP Forum in Naples, FL recently!

I've had the privilege of working with many NRRPT Board and Panel members since starting with the registry 29+ years ago. Some of them come and go but when I get the chance to talk to them they always seem to have great memories of their time spend serving the registry.

Left to right—top picture

- Brad Mitchell began on the Panel of Examiners in 1991. He currently is a Principal Evaluator, Radiological Protection at INPO.
- Willie Harris began on the Panel of Examiners in 1999. He currently is the Director of Radiation Protection at Exelon Corporation.

Left to right—bottom picture

- Paul Lovendale was Chairman of the Board from 1986—1993. He is currently retired.
- Bill Peoples was Chairman of the Board from 1998—1999. He currently works for BHI Energy and still serves on the Panel of Examiners!

Thanks guys for your years of service to the registry. Remember, your presence is always welcome at any of the Board and/or Panel meetings!

Registry members: if you're interested in joining the Board/Panel you can contact myself—DeeDee McNeill DeGrooth at 401-637-4811 / nrrpt@nrrpt.org or Dave Wirkus at 208-227-0187 / wirkdl63@gmail.com.

Inside This Issue

Contacts

Dave Tucker, Chairman of the Board
tuckerdavidm@gmail.com

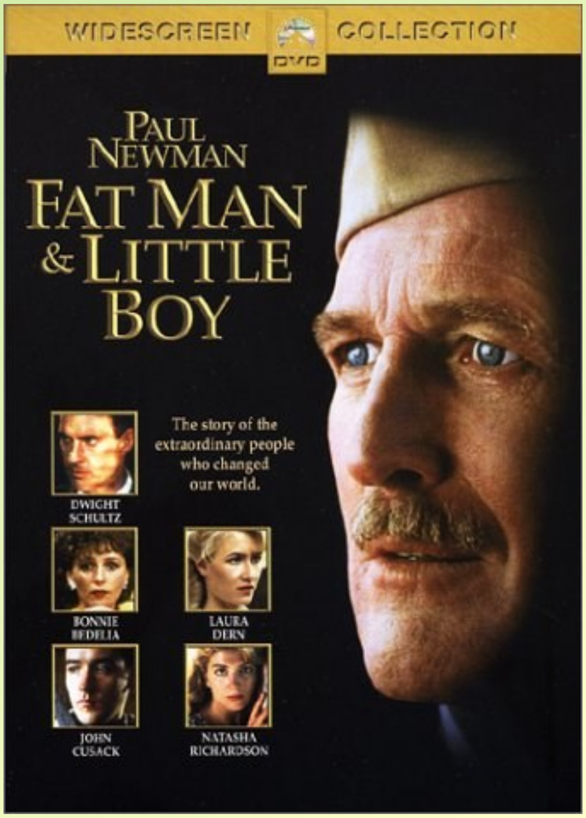
DeeDee McNeill DeGrooth
(401) 637-4811 (w)
nrrpt@nrrpt.org

Todd Davidson
(636) 448-8633 (cell)
t-davidson@sbcglobal.net

Another **NRRPT** Blast from the Past

RAD MOVIE REVIEWS!

PART 3 – FAT MAN AND LITTLE BOY – THE STORYLINE – FACT VS. HOLLYWOOD



DVD Cover Paramount Home

As we all know, the movie tells the story of making the first three atomic weapons. The test at Alamagordo, Fat Man, and Little Boy.

Fact: General Groves was obsessed with security.

Fact: Security and the scientists didn't mix (think exchange of ideas). Security was so poor that secrets were smuggled to the Soviet Union by Los Alamos employees Klaus Fuchs and David Greenglass (Julius Rosenberg spy ring).

Fact: Leo Szilard is the father of the atomic bomb. He brought in Edward Teller (Hungary), Enrico Fermi (Italian physicist from fascist Italy), Dr. Isidor I. Rabi (Austria) and got Einstein to write President Roosevelt.

Fact: Szilard and Fermi both demonstrated fission of uranium (although they did it after Otto Hahn did it on his dining room table in 1938).

Fact: Groves hated Szilard – thought him insubordinate; tried to get him fired by the Secretary of War.

Fiction: Groves met Szilard at the Metallurgical Laboratory in Chicago – definitely not while Szilard was in a bath tub.

Fiction: There was no Richard Merriman although the petition (based on the Franck Report co-authored by Szilard) was real and was circulated in Chicago.

Fiction: Oppenheimer and Groves didn't just argue about the free exchange of ideas, it was open warfare. Oppenheimer succeeded in having nightly meetings of cleared personnel and no topic was off limits. This was probably the source of Klaus' information to the Soviets.

Fiction: Like the movie portrayed, Groves knew of Oppenheimer's like of communism, but Groves fought hard to keep Oppenheimer on the project. It wasn't until the U.S. started work on the hydrogen bomb after the war that Groves black-balled Oppenheimer.

Fiction: Groves hated and bullied the scientists – except for Szilard, Groves got along well with everyone. He wasn't a bully.

Fiction: Louis Slotin (Canada) was exposed and died 9 months after the weapons were dropped in Japan. "Tickling the dragon's tail" was real.

Pete Darnell, RRPT, CHP

NRRPT Blast from the Past!

Good evening Mr. and Mrs. NRRPT, from border to border and coast to coast and all the ships at sea. Let's go back in time…

<u>The Date:</u> June 16, 1958

<u>The Event:</u> The first known process plant nuclear criticality accident.

<u>The Place:</u> Building 9212, C-1 Wing, in a processing area during an enriched uranium recovery operation at the Y-12 Plant in Oak Ridge, Tennessee.

<u>The Cause:</u> Geometry and administrative controls failures.

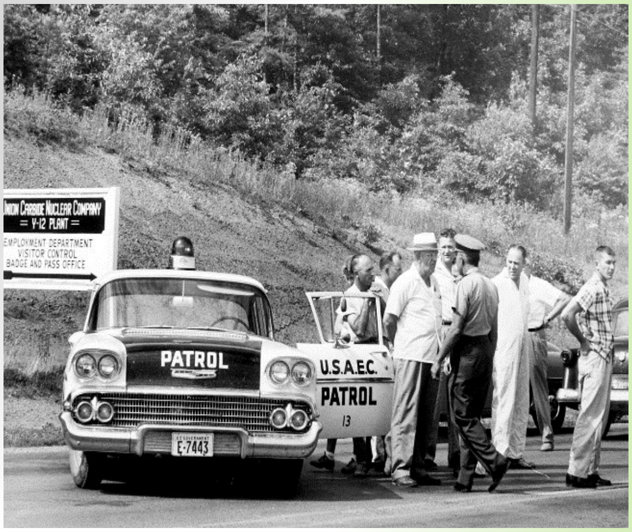
<u>The Setup:</u> Y-12 was changing from a policy of administrative control practices to a policy of geometric control practices in uranium recovery operations. Oak Ridge was redesigning the B-1 Wing of Building 9212 to allow processing without transfer from favorable geometry equipment; however, high concentrations of uranium were present at a number of points in the B-1 Wing equipment. Controls banned unfavorable geometry containers (like waste baskets, mop buckets, desk drawers, and tool boxes) in the process area of B-1 Wing.

The C-1 Wing of Building 9212 used administrative controls and some physical geometry control for nuclear criticality safety. They relied on rigid administrative controls (batching procedures, duplication of measurements/analyses) because unfavorable geometry containers were still used. Another control required dilute solutions and/or small uranium quantities so that the unfavorable geometry containers did not represent a significant problem.

At the time of the nuclear criticality accident, Oak Ridge had failed to complete sections of the B-1 Wing so they installed a temporary transfer pipeline from the B-1 Wing to the C-1 Wing. The B-1 Wing produced uranyl nitrate and the C-1 Wing received the solution. Consequently, the concentration of solution in C-1 Wing could be the same as the concentration of solution in B-1 Wing.

<u>The Accident:</u> The equipment in the B-1 Wing was ready for production before the C-1 Wing became ready to receive solution. The B-1 Wing started-up (it had storage facilities for the solution) before the C-1 Wing to reduce equipment downtime.

A single control valve isolated the process equipment of the B-1 Wing from storage tanks in the C-1 Wing. Uranyl nitrate solution started leaking at a low rate through the control valve into the C-1 Wing during the morning of June 16, 1958.



AEC responders (Knoxblogs.com)

Workers in the C-1 Wing closed a secondary control valve upstream from the leaking solution after noting the leak. Closure of the second valve sent the leaking uranyl nitrate into a C-1 Wing favorable geometry storage tank and associated piping.

Enter a new shift… Verify the first control valve closed… Perform a leak test in the C-1 Wing with water… Open a third valve and watch the slow flow of a yellow liquid into a 55 gallon drum and wait 15 minutes… Oops! Blue flash. The solution goes critical several times – each with its own burst. Miraculously, none of the contents of the drum to splashes or evaporates. The reaction stops 20 minutes later when the solution dilutes with the leak-test water still flowing into the drum.

Continued on next page

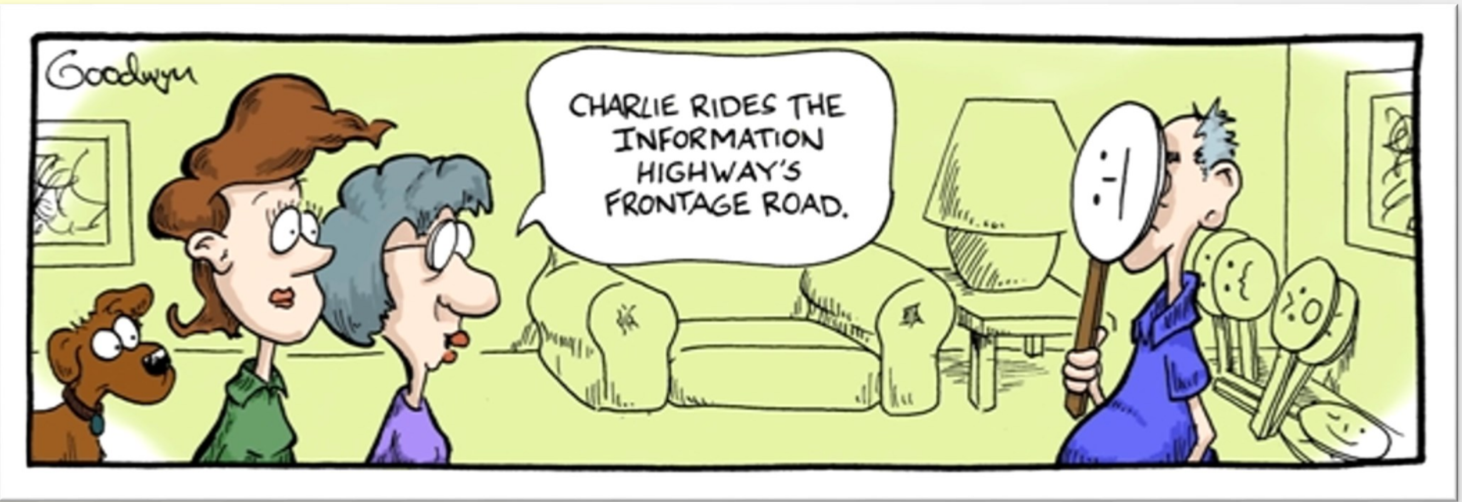
The Aftermath: Eight Y-12 employees were near the drum. Three of these employees received between 23 and 70 rad. The five remaining employees received radiation doses between 235 and 365 rad. Interestingly, 4 employees lived until their 70's, one until his 80th birthday, one died young (a heavy smoker), and 2 remain alive as of 2012.

Pete Darnell, RRPT, CHP, after-the-fact reporter

Welcome New NRRPT Members

Congratulations to the following individuals who successfully passed the **NRRPT** Examination on February 24, 2018:

Dustin L. Anderson
Jeffrey R. Chapman
Pradyot Chowdhury
Robert M. Crotty
Kelly S. Gillette
Preston S. Patterson
Lucas V. Ray
Daryl Reynolds
Hereld Stuart
Ronald D. Welch
Elias Zervoudis
Daniel E. Ziccarelli



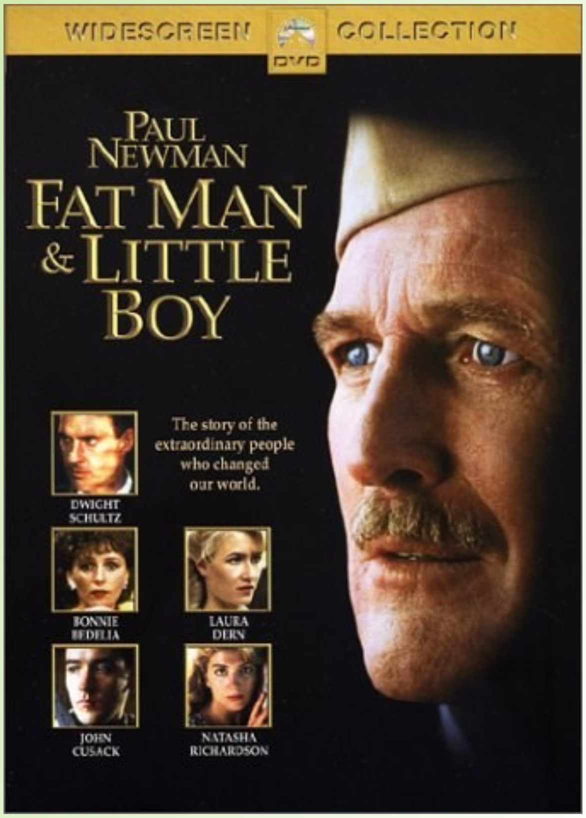
NRRPT Board and Panel Meeting in Cleveland, OH

Welcome to the Board of Directors!
Jon Biela

Jenifer Kautzman, ACE Review Lead meets with the NRRPT Board during the ACE review. More information regarding how the review process went will be in the next NRRPT News!

Rad Movie Reviews!

Part 4 – Fat Man and Little Boy – The Atomic Bomb Timeline



DVD Cover Paramount Home

Chronology for the Development of the Atomic Bomb – facts, not fiction here. Sorry about the length.

1895: X-rays discovered, Wilhelm Roentgen (Germany).

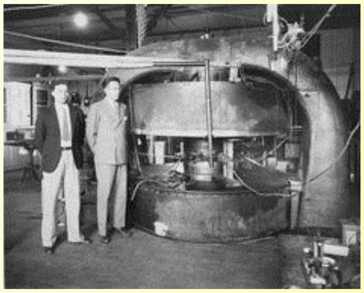
1896: Radioactivity discovered, Henri Becquerel (France).

1905: Theory of relativity, Albert Einstein (Germany).

1911: Nuclear theory of the atom, Ernest Rutherford (England).

1914: H. G. Wells publishes "The World Set Free" – describes the creation of an atomic weapon (England).

1932: Cyclotron invented (accelerates sub-atomic particles), Ernest Lawrence and M. S. Livingston (United States).



1933: Leo Szilard hits upon the idea of a chain reaction (England). Otto Hahn produces fission (Germany)

1934: Enrico Fermi produces fission (Italy).

1935: Edward Teller immigrates to the United States. Szilard takes out secret patent on chain reaction (England).

1938: Otto Hahn sends paper to Lise Meitner to see if she concurs that he has split the uranium atom. Meitner and Otto Frisch confirm nuclear fission (Sweden).

1939:

January 1: Enrico Fermi immigrates to the United States after receiving the Nobel Prize.

January 26: The American Physics Society sponsors a meeting with Niels Bohr, Fermi, Otto Stern, H. C. Urey, Isidor Isaac Rabi, and Teller.

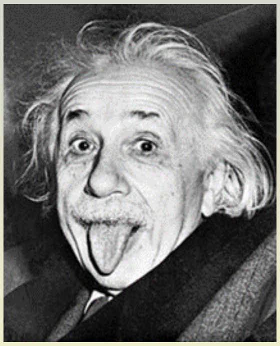
March 17: Fermi talks with the United States Navy about the development of a nuclear bomb.

August 2: Szilard, Teller, and E. Wigner persuade Albert Einstein, now living in the United States, to warn the president about the possibility of nuclear weapons. Einstein writes President Franklin D. Roosevelt to alert him about the importance of doing research on nuclear weapons so that the United States would beat Germany in the race for the bomb.

August 19: FDR informs Einstein he has set up a committee to study uranium.

September 16: A secret conference is held in Berlin to discuss nuclear fission.

September 26: The German nuclear bomb project is organized with Werner Heisenberg, Paul Harteck, Kurt Diepner, and Erich Bagge.



October 11-12: Alexander Sachs speaks with FDR about Einstein's letter and the necessity of getting an atomic bomb before the Germans.

October 21: First meeting of the Uranium Committee (United States).

December 6: Heisenberg makes first report to the German Department of War on atomic weapons.

1940:

February 1: Otto Frisch and E. Peierls present idea of achieving critical mass by using highly enriched uranium (England).

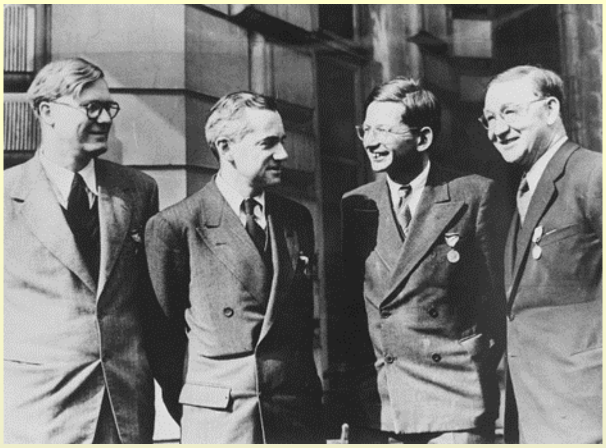
February 2: Fermi and Szilard given $6000 by U.S. government to purchase graphite.

February 29: A. Nier separates uranium 235.

May 3: German troops occupy Norway, seizing the world's only production plant for heavy water.

May 10, 1940: FDR appeals for cooperation to the American Scientist Federation. Teller decides on the basis of this speech to dedicate himself to weapons research.

June: H. Halban and L. Kowarski escape to England carrying 180 pounds of heavy water and all the data of Jolie Curie. Vannevar Bush is named head of the National Defense Research Committee.



Spring-Summer: Separation of isotopes studied in the United States and with the Military Application of Uranium Detonation (MAUD) committee in England (William Penney, Frisch, Peierls, and John Cockroft).

1941:

February 23: Glenn Seaborg discovers a new element and names it plutonium (United States).

March: Peierls calculates critical mass of uranium 235 (England).

April: Japanese army approves atomic bomb research.

June: The Soviets begin research on atomic weapons.

June 23: MAUD committee presents convincing evidence that uranium-235 can be made into a bomb.

July 7: MAUD transferred to the United States.

July 11: Ernest Lawrence suggests possibility of fission of plutonium, thus creating a plutonium bomb.

November 6: The Compton committee, headed by Arthur Compton, predicts that a uranium bomb was possible within 3-4 years at the cost of $50-$100 million dollars.

December 6: FDR authorizes the establishment of the Manhattan Engineering Project under the Office of Scientific Research and Development.

December 9: Compton and Bush begin plutonium bomb project.

December 18: The S-1 Committee is created by Bush with a 6 month budget of $651,000 to develop a nuclear bomb. Lawrence is on the S-1 Committee and shortly afterwards builds the Calutron (named after the University of California) to separate U-235 and make it useable for a bomb.

1942:

January 24: Atomic research concentrated at the University of Chicago in the Metallurgical Laboratory.

June 11: Oppenheimer arrives at the Metallurgical Laboratory.

June 13: FDR told that a plutonium bomb is feasible by Bush and Conant.

June 17: Plutonium production begins at Washington University and St. Louis University.

June 25: The first S-1 Committee meeting with scientists and the military conducted.

July 27: First plutonium arrives at Chicago Metallurgical Laboratory.

August: The Army Corps of engineers creates a new District organization called the "Manhattan Engineer District (MED)."

September 17: Colonel Leslie Groves promoted to Brigadier General and takes charge of the MED.

September 26: Groves obtains emergency procurement priority (AAA) so the MED can acquire materials over any other project.

October 5: Groves visits the Metallurgical Laboratory and meets key scientists for the first time (Szilard and Oppenheimer).

October 15: Groves asks Oppenheimer to be head of Project Y – a new laboratory for physics research on weapons later moved to Los Alamos as part of the MED.

November 5: Construction of a uranium isotope separation plant begins at Oak Ridge, Tennessee.

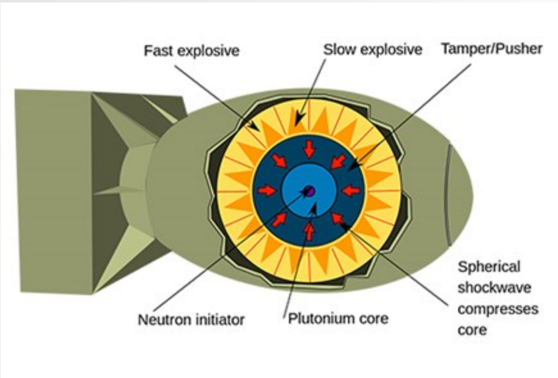
December 2: Fermi produces the first sustained and controlled nuclear reaction. Soon after, Bush gets FDR to approve expenditure of $400 million to develop the bomb.

1943:

January: Planning for construction of Hanford plutonium reactors.

March 15: Oppenheimer moves the MED to Los Alamos, New Mexico.

April: Seth Neddermeyer begins research on implosion while concurrent explosion techniques research continues. The University of California is contracted with to manage Los Alamos.



July 4: Neddermeyer conducts the first implosion experiments.

August: 20,000 people working construction at Oak Ridge. 5,000 working constructing at Hanford.

September 20: Johann Vonn Neumann describes a more efficient way to achieve implosion using a smaller critical mass. Oppenheimer recruits George Kistiakowsky to lead the explosives research.

October: Project Alberta (atomic bomb delivery program) begins. Norman Ramsey begins work to modify aircraft for nuclear bombs.

1944:

January 11: Neddermeyer replaced by Kistiakowsky and Teller for implosion research and development.

April 5: Los Alamos received first plutonium from Oak Ridge.

May: Los Alamos staff exceeds 1200 employees. Teller removed from implosion research (personality conflicts and obsession with the hydrogen bomb).

June: Oppenheimer takes charge of implosion research.

July: Experiments with using a lens to trigger explosion begin and the design for the gun gadget neutron initiator is completed.

October 27: Oppenheimer approves bomb test in the Jornada del Mueurto (Journey of Death) valley of the Alamagordo Bombing Range.

December: First successful explosive lens test conducted at Los Alamos (implosion bomb).

1945:

January 18: The experiment of "tickling the Dragon's tail" is conducted by Otto Frisch with U-235 going critical.

February: The gun device for the uranium bomb is completed.

April 12: FDR dies of a brain hemorrhage and Harry Truman becomes president. The Riken Scientific Institute in Tokyo is destroyed and with it the Japanese atomic program.

April 13: Truman is informed by Secretary of War Harry Stimson of the existence of an atomic bomb project.

April 17: The ALSOS unit (ALSOS is a Greek word meaning groves), sent by Groves to capture men and materials involved in the German atomic effort, finds German uranium ore and sends it to Los Alamos.

April 23: ALSOS seizes German reactor at Heigerloch.

April 24: ALSOS arrests German atomic scientists, including Heisenberg. ALSOS discovered the German bomb project was not close to building an atomic bomb.

April 25: Truman receives detailed report on the MED from Stimson and Groves.

May 31: Plutonium critical mass experiments begin at Los Alamos.

June 11: The Franck Committee report recommends notification before use of the atomic bomb. Seven scientists in Chicago recommend a demonstration before the bomb is used on a city.

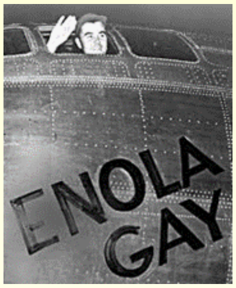
July 11: MED begins the assembly of the Gadget, the first uranium bomb.

July 13: The Gadget is assembled.

July 14: The Gadget is hoisted to the top of a 100 foot test tower.

July 16, at 5:29:45 a.m.: The Gadget is detonated in the first atomic explosion in history. Truman receives notification of successful test while at the Potsdam Conference with Winston Churchill and Joseph Stalin. Four hours after the test, the USS Indianapolis carries Little Boy to the Tinian Islands.

July 31: MED completes assembly of the uranium bomb, Little Boy.

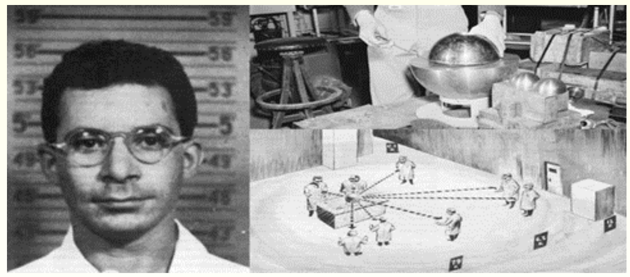


August 6: Little Boy (uranium bomb) loaded onto "Enola Gay" and takes off to bomb Hiroshima. At 8:16:02 Hiroshima time, the bomb is released and explodes at an altitude of 1850 feet, 550 feet from the target, the Aioi Bridge.

August 9: Fat Man (plutonium bomb) is loaded onto "Bock's Car" and takes off to bomb Kokura. Because that target is obscured, Nagasaki is bombed instead at 11:02 Nagasaki time, exploding 1950 feet over the city.

Special Notes: In case you think the pic of Einstein is fake, it's not. Arthur Sasse (UPI Photographer) caught the pic on Einstein's birthday on March 14, 1951. Einstein was 72 and ordered 9 copies of the pic for himself!

Picture Credits: All the pictures are from public archives (except as noted above). This author and article does not claim ownership.



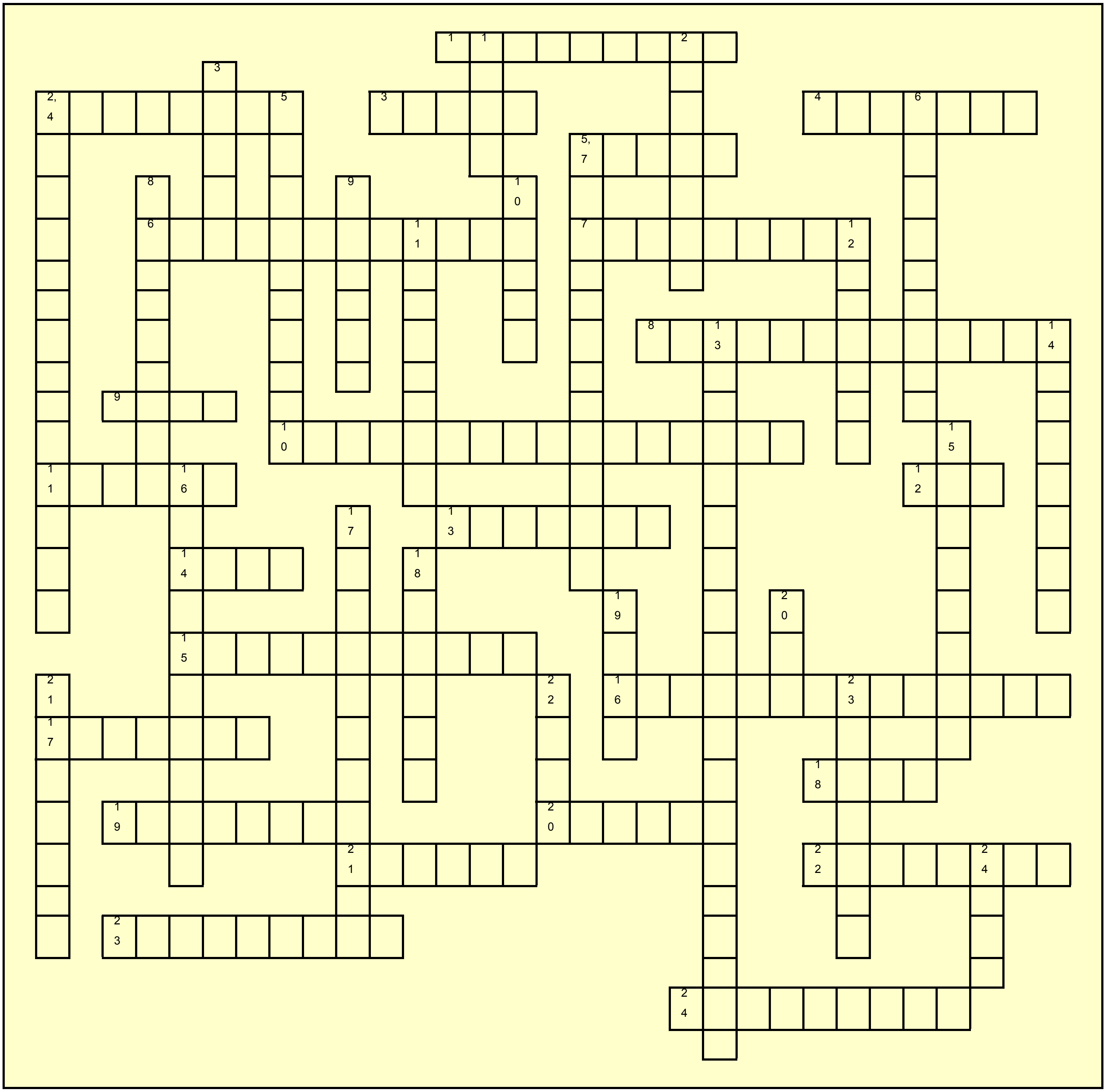
Louis Slotin (Canada) "tickling the Dragon's tail"

Pete Darnell, RRPT, CHP

Bio on Panel Member Nick Christiansen!

Nicholas T. Christiansen is a Radiological Controls Supervisor working at the Materials and Fuels Complex at Idaho National Laboratory. Nick has a Bachelor of Science in Radiation Protection, is a certified RSO, and has been a NRRPT member since 2012. Nick has experience in the Naval Nuclear Propulsion Program, Department of Energy, Decontamination and Demolition, Radiopharmaceuticals, and Commercial Nuclear Power industry sectors. He is actively pursuing a Master of Science in Nuclear Technology Management. Outside of work, Nick is married and has 5 children and can be found participating in powerlifting, adrenaline sports, and motorsports.

Crossword Puzzle



Crossword Puzzle Answers on back page

Across

1	The loss of hair is called ______.
2	A widely used detector for slow ________ is a BF3 proportional tube.
3	The _____ Isolation Pilot Plant (WIPP) is located near Carlsbad New Mexico
4	For linear tail pulses, the most significant parameter besides amplitude is the rise time of the ________ edge of the pulse.
5	True or False; In Vivo bioassay counts urine or fecal samples externally
6	In its original design, the ion chamber was used in the form of an ___________
7	By definition, noise is any _________ fluctuation that appears superimposed on a signal source.
8	Non-stochastic effects are sometimes called _______ effects
9	One of the first personal dosimeter devices was the photographic ______ badge
10	An acute, whole body (DDE) radiation exposure of approximately 8 Gy will likely suffer symptoms of up to which level of the Acute Radiation Syndrome
11	The detector that is unable to distinguish the energies of the incoming rays is known as a ____ counter
12	The precursor to both the DOE and NRC was the ______
13	The Multi-Agency Radiation Survey and Site Investigation Manual
14	Full width half max
15	Absorbed dose may be measured by _______ since much of the energy lost by radiation in matter appears in its final form as heat.
16	Mixed waste has both radiological and _____ ________ characteristics
17	Air purifying respirators use ________ air and provide no protection for radioactive vapors and gases.
18	The probability of a neutron interaction (Cross-section) is expressed in what unit.
19	The first step in a PM tube is the conversion of ________ light photons into electrons.
20	The _____ dosimeter is a cadmium shielded dosimeter and detects thermal neutrons leaving the body of the wear-er
21	Iodine-131 is a radionuclide most suited to __________ bioassay measurements?
22	In vitro ________ measures the radioactivity being eliminated from the body.
23	He was the discoverer of radioactivity, for which he also won the 1903 Nobel Prize in Physics
24	What element is used in a HPGe detector?

Down

1	The mean free_________ the average distance of photon travel in a medium between interactions.
2	The Danish physicist and chemist who discovered that electric currents create magnetic fields, which was the first connection found between electricity and magnetism
3	An electron volt, erg, and ________ are all units of energy.
4	The upper respiratory pathway
5	The three gamma-ray interactions of any real significance are photoelectric absorption, Compton _________, and pair production.
6	The "D" in CANDU stands for ______
7	The process of _______ is the prompt emisssion of visible radiation from a substance following its excitation by other means.
8	Wt, used in calculating a CEDE is the Tissue ______ Factor
9	Activated charcoal is used to collect airborne samples of what gas
10	_____ is the energy per unit mass transferred to charged particles by uncharged particles passing through a substance.
11	Early generation electronic dosimeters were often called ___________.
12	DAC stands for the _____ Air Concentration
13	In shipping a radioactive package, the T.I. is shown on the shipping papers, what is T.I.
14	A nuclear reactor core immersed in a pool of water shows a blue glow that is known as ________ radiation.
15	The P in EPD
16	Air sampling techniques are based on passing a known volume of air through a filter medium of known _________.
17	Effective half-life considers two factors, the biological elimination rate and the in situ _______ decay of the radionuclide.
18	The T in TLD
19	He was exclusively awarded the Nobel Prize in Chemistry in 1944 for the discovery and the radiochemical proof of nuclear fission
20	100 ergs of energy deposited in 1 gram of any absorber is know as a
21	Pulse height resolution is the ratio of full width at half _______ to photopeak energy.
22	A filter that removes more than 99.97% of 0.3 micron diameter particles is called a ____ filter
23	This decay chain includes Radon 222
24	When used In pressure demand mode, this device has a protection factor of 10,000

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B & B ENVIRONMENTAL SAFETY, INC.

AWARENESS, RESPONSE, SOLUTIONS

B & B Environmental Safety, Inc. (BBES) is a minority-owned, CVE-Certified Service-Disabled Veteran-Owned Small Business (SDVOSB) that provides a wide array of environmental services. BBES is headquartered in the Central Valley of Northern California. BBES was founded in 2005 as an environmental consulting company, specializing in radiological services. Since its inception, BBES became incorporated in 2007 and has expanded to have a regional office located in the Denver, Colorado Metro Area as well as numerous satellite offices. BBES offers its services throughout the entire United States and its territories. In addition to having an active California State Radioactive Materials License, BBES also maintains a Nuclear Regulatory Commission Broad-Scope Radioactive Materials License. When necessary and permissible, BBES will enact our NRC license to commence operations while any State-required RML issuance is pending.

More than just being a SDVOSB, BBES believes in the commitment to excellence demonstrated by those who currently or have previously served in the US Armed Forces. With most of BBES' employees being either Veterans or family members of Veterans, Trained First Responders, or other emergency service personnel, the corporate culture has evolved to that of a dedicated service organization that strives for excellence. BBES also continually looks for self-motivated, like-minded individuals who will commit to being an asset to the company.

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Key Benefits

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- Perfect Safety Record—No reportable lost time incidents
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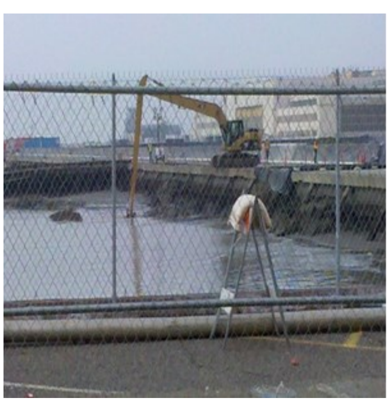

For more information and inquiries, contact:

Randall Baugh
B & B Environmental Safety, Inc.
Corporate Marketer
710 Kipling St.
Suite 105
Lakewood, CO 80215
(720) 550-8443
randall@bbensafety.com
www.bbensafety.com

San Onofre Nuclear Generating Station

For more than 40 years, SONGS generated power for Southern California – in fact, units 2 and 3 were capable of generating 2,200 megawatts of electricity, enough power to serve 1.4 million average homes at any point in time. SCE announced in June 2013 that Units 2 and 3 will be permanently retired. Unit 1 was retired in 1992.

SCE is committed to a safe and timely decommissioning of the San Onofre nuclear plant that protects the environment and our customers' economic interests. SCE established a set of guiding principles focused on safety, stewardship and engagement that will guide the successful decommissioning of SONGS and can make San Onofre a model for the industry.

SONGS is proud of its' continued dedication of registered RRPT members that are represented in various organizations across the station.

McMaster Nuclear Reactor

The McMaster Nuclear Reactor (MNR) first became operational in 1959 and was the first university-based research reactor in the British Commonwealth. Originally designed to operate at a maximum power of 1 MW, MNR was upgraded during the 1970s to its current rating of 5 MW with a maximum thermal neutron flux of 1 x 10^{14} neutrons/cm^2s. MNR is classified as a medium flux reactor and it is by far the most powerful research reactor at a Canadian university – the handful of so-called “Slowpoke” reactors at other institutions typically operate at a power of 0.02 MW.

Services Provided: Assay Equipment and Services, Uranium; Irradiation Services; Laboratories, Chemical; Neutron Activation Analysis Services; Neutron Radiography; Radiochemicals; Radioisotopes; Research and Development

Susan Jack
1280 Main Street, W, NRB A331
Hamilton, Ontario L8S 4K1

jacks@mcmaster.ca
http://mnr.mcmaster.ca

If you’d like to join the Panel of Examiners please contact one of the following:

Exam Panel Chairman—Dave Wirkus—wirkdl@gmail.com

Executive Secretary—DeeDee McNeill DeGrooth—nrrpt@nrrpt.org

Ameren Missouri-Callaway Energy Center

Bob Farnam
P.O. Box 620
Fulton, MO 65251
(573) 676-8784
(573) 676-4484 (fax)
refarnam@cal.ameren.com
www.ameren.com

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Shannan Ryll
473 Silver Lane
East Hartford, CT 06118
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860-569-0277 (fax)
sryll@cabreraservices.com
www.cabreraservices.com

Cabrera is a trusted integrator for radiological remediation and munitions response solutions. We bring world class expertise in health physics and munitions response along with a broad base NRC radioactive materials license to solve our client's toughest challenges. As an integrator, we bring our clients:

- Expertise in securing site closure/release;
- Smart design of characterization, sampling and FSS programs; and
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Detroit Edison Fermi 2

Richard LaBurn
6400 N. Dixie Hwy
Newport, MI 48182
(734) 586-4974
(734) 586-1883 (fax)
laburnr@dteenergy.com
www.dteenergy.com

Detroit Edison operates the Fermi 2 Nuclear Power Plant located in Monroe, MI along the shores of Lake Erie. Fermi is a 1200 MW power plant supplying electricity to the metropolitan Detroit area.

Day & Zimmermann

We do what we say

John Ellison
5800 East Skelly Drive, Ste 800
Tulsa, OK 74135
888-488-0880
918-743-4867 (fax)
john.ellison@dzatlantic.com
www.dayzim.com

Day & Zimmermann provides radiological services to meet the unique demands of the nuclear power industry. We deliver all levels of health physics, decontamination technicians and radiological support as a trusted partner to numerous commercial nuclear power stations across the U.S.

Duke Energy Corporation

Larry Haynes
526 S. Church Street, MS-EC07F
Charlotte, NC 28202
(704) 382-4481
(704) 382-3797 (fax)
larry.haynes@duke-energy.com
www.duke-energy.com

The new Duke Energy, which is the product of a merger with Progress Energy, is the largest electric power holding company in the United States with more than $100 billion in total assets. Its regulated utility operations serve more than 7 million electric customers located in six states in the Southeast and Midwest. Its commercial power and international business segments own and operate diverse power generation assets in North America and Latin America, including a growing portfolio of renewable energy assets in the United States. Headquartered in Charlotte, N.C., Duke Energy is a Fortune 250 company traded on the New York Stock Exchange under the symbol DUK.

171 Grayson Rd.
Rock Hill, SC 29732
(803) 366-5131
frhamsc@frhamsafety.com

FRHAM SAFETY PRODUCTS, INC.

318 Hill Ave.
Nashville, TN. 37210
(615) 254-0841
frhamtn@frhamsafety.com

Incorporated in 1983, Frham Safety Products, Inc. continues its sole purpose of manufacturing and distributing products to the Nuclear Power Utilities, DOE, DOD, Naval facilities as well as several industrial accounts and related users of safety supplies and equipment.

From the creators of proven products such as the Totes Overshoe and the Frham Tex II, Frham continues their objective to provide products and services which meet or exceed the specifications set forth by customers and the industries that it serves. These revolutionary new concepts include Life Cycle Cost Management (LCCM), Mobile Outage System Trailer (MOST) and Certified Disposable Products (CDP).

- LCCM offers products through a systematic approach of life cycle pricing to include disposal at the purchase point.
- MOST provides onsite product storage stocked systematically specified by the customer for easy access and stringent inventory control.
- CDP consists of proven disposables for every application which includes standard and custom specifications to meet your disposable needs.

Among these services and products, Frham also supplies chemical, biological and radiological equipment which will support applications for domestic, biological, nuclear, radiological or high explosive incident sites. This equipment is able to sample, detect and identify chemical warfare agents and radiological materials as well as provide safe-barrier, personal protection from chemical warfare, biological warfare, radiological and TIC/TIM environments.

F&J Specialty Products, Inc.

Frank M. Gavila
404 Cypress Road
Ocala, FL 34472
352.680.1177/352.680.1454 (fax)/fandjspeciaty.com

ISO 9001:2008 certified manufacturer of traditional and advanced-technology air sampling instruments, airflow calibrators, filter holders, consumables and accessories.
Air Sampler product lines include; high and low volume, tritium, C-14 and battery-powered air sampling systems. Various models are available for both portable and environmental sampling systems.
Consumable product line includes; filter paper, TEDA impregnated charcoal cartridges and silver zeolite cartridges. F&J provides comprehensive collection efficiency data for radioiodine collection cartridges.
F&J manufactures the premier line of small lightweight emergency response air samplers which can operate from line power, on-board batteries or an external DC power source. Battery powered units have on-board charging systems.

HI-Q ENVIRONMENTAL PRODUCTS COMPANY, INC.
Air Sampling & Radiation Monitoring Equipment, Systems & Accessories

HI-Q Environmental Products Company is an ISO 9001:2008 certified designer/manufacturer that has been providing air sampling equipment, systems and services to the nuclear and environmental monitoring industries since 1973. Our product line ranges from complete stack sampling systems to complex ambient air sampling stations. HI-Q's customers include the National Laboratories and numerous Federal and State Agencies in addition to our domestic and international commercial customer base. Our product catalog includes: Continuous duty high & low volume air samplers, radiation measurement instrumentation, radiation monitoring systems, air flow calibrators, radioiodine sampling cartridges, collection filter paper and both paper-only or combination style filter holders. Along with the ability to design complete, turn-key, stack and fume hood sampling systems, HI-Q has the capability to test ducts and vent stacks as required by ANSI N13.1-1999/2011.

Master-Lee Decon Services

Robert Burns
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Medford, NJ 08055
(609) 654-6161
(609) 654-1404 (fax)
burns-ml@comcast.net

Master-Lee is a leading supplier of refueling, maintenance, inspection, operations and outage management services for PWR Nuclear Power Plants in the U.S. Market and has supported the major NSSS companies in the performance of similar tasks at BWR sites. Master-Lee also designs, fabricates and supplies specialty products, tools and parts in support of our various product lines. These capabilities are provided by our broad range of Product Lines: Refueling and Related Services; Pump and Motor Services; NDE – Eddy Current Testing Services; Specialized Reactor Services; Decontamination Services; Decommissioning Services; Engineered Products; and Technical Services.

MJW Technical Services

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Mirion Technologies

Audrey Summers
5000 Highlands Parkway, Ste 150
Smyrna, GA 30082
(770) 432-2744
(770) 432-9179 (fax)
asummers@mirion.com
www.mirion.com

Mirion Technologies is a leading provider of innovative products, systems and services related to the measurement, detection and monitoring of radiation. The company delivers high quality, state of the art solutions that constantly evolve to meet the changing needs of its customers. With the addition of the Canberra brand in 2016, Mirion expanded its portfolio and the breadth of its expertise to bring a new standard of solutions to the market. Every member of the Mirion team is focused on enhancing the customer experience by delivering superior products, exceptional service and unsurpassed support. Mirion Technologies: Radiation Safety. Amplified.

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Roger Aguilera
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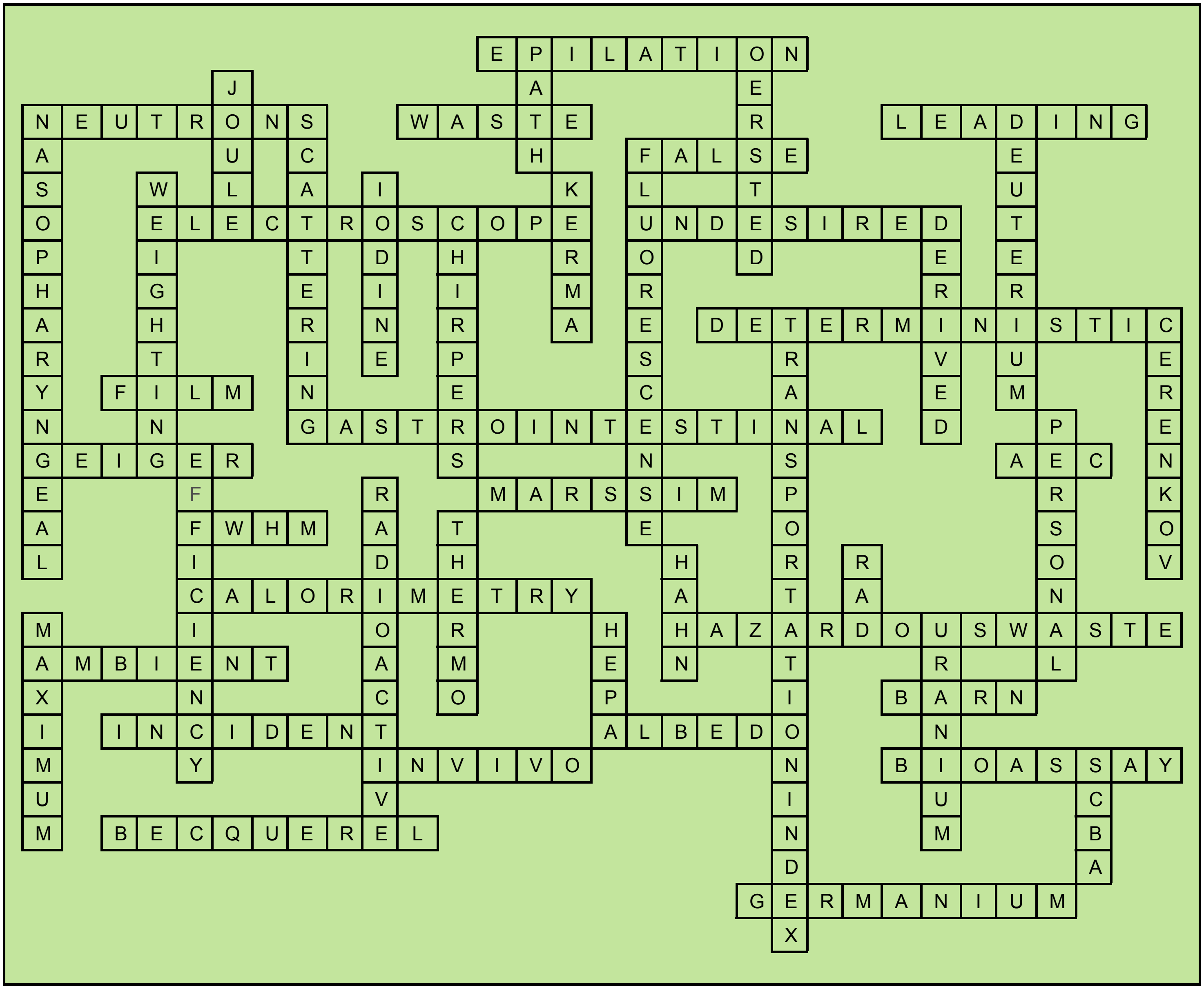
More than fifty registered Radiation Protection Technologists are proud to work at the South Texas Project's two nuclear power plants. These plants, some of the world's newest, produce more than 2500 megawatts of electricity. The plants, and the team that operates them, set industry standards in safety, reliability and efficiency.

Crossword Puzzle Answers



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