# THE DISPATCH

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## Inside this Issue



## Program Manager's Corner

Welcome to the third edition of the DTRIAC Dispatch and the last issue in our 50th Anniversary year. This issue highlights film and photos in our media collection. Since the adoption of the Comprehensive Test Ban Treaty (CTBT) by the United Nations General Assembly in September 1996, those nuclear nations that signed, and in some cases ratified, the treaty have ceased all nuclear testing. It's amazing to witness what today's technology can do with yesteryear's media and how it supports research efforts in a post-CTBT world.

Without continued nuclear testing but with an ever more pressing need to recognize and characterize nuclear detonations—intentional, unintentional, dirty bombs, etc.— we must lean on data from past testing to extrapolate new, useful information that can assist us in a variety of efforts. The efforts include using older data and imagery with newer technologies and equipment to create improved models and simulators. These tools can improve our predictive analysis capabilities. For example, data extracted using a one-of-a-kind, high-speed, high-resolution film scanner and digitizer from the original film negatives shot during nuclear testing decades ago will greatly help the Lawrence Livermore National Laboratory with some of their research efforts. (LLNL article on page 5)

As DTRIAC enters its 51st year of serving the nation, we look forward to making continued progress on our IT system upgrades in the coming year. STARS users will see a notable improvement in their current online tool come the second half of 2012. The theme for next quarter will be tied to EMP effects and system hardening efforts and how DTRIAC assists in those efforts. We are happy to include short articles for any future issues of The Dispatch from the entire CBRN and CWMD communities. Please let us know if you have any comments or questions at all. You can contact me at craig.hess@dtra.mil or at (505) 846-2071.

Thanks,
Lt Col Craig Hess
DTRIAC Program Manager

## Contact Us


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or visit us at
www.dtriac.dtra.mil


## Ask the IAC

### How Do I Find and Get Specific Film or Pictures from DTRIAC?

The DTRIAC media collection includes more than 20 thousand motion picture clips and 2 million still photographs. Individuals with a Scientific and Technical Information Archival and Retrieval System (STARS) account can research these holdings directly from their account. If you prefer to have DTRIAC personnel research the availability of media, U.S. government employees and their contractors can contact the DTRIAC Media Manager directly at 505-846-4494 or email dtriac@dtra.mil; attention Media Manager. All other individuals are required to submit requests in writing through the DTRA Public Affairs Office, dtra.publicaffairs@dtra.mil. Requests must include the requestor's name, organization or affiliation, phone number, and email address. Once a request for media is submitted, DTRIAC personnel will research the availability of products and even suggest other items in the collection that may suit the requestor's needs. If the requested film or photo material is not readily available, it may take 1 to 2 weeks to research the collection to find a best match item.

# Understanding Nuclear Yields

Understanding nuclear yields was critical in the development of the U.S. nuclear stockpile and remains critical in the post-Cold War era in which we find ourselves searching for illegal atomic and thermonuclear detonations. This information is integral in understanding weapon performance, military efficacy, and treaty compliance. Yields of nuclear explosions can be very hard to calculate, even using numbers as rough as in the kiloton or megaton range. Even under very controlled conditions, precise yields can be very hard to determine; for less controlled conditions, the margins of error can be quite large. Yields can be calculated in a number of ways, including calculations based on blast size, blast brightness, seismographic data, and radiochemistry.

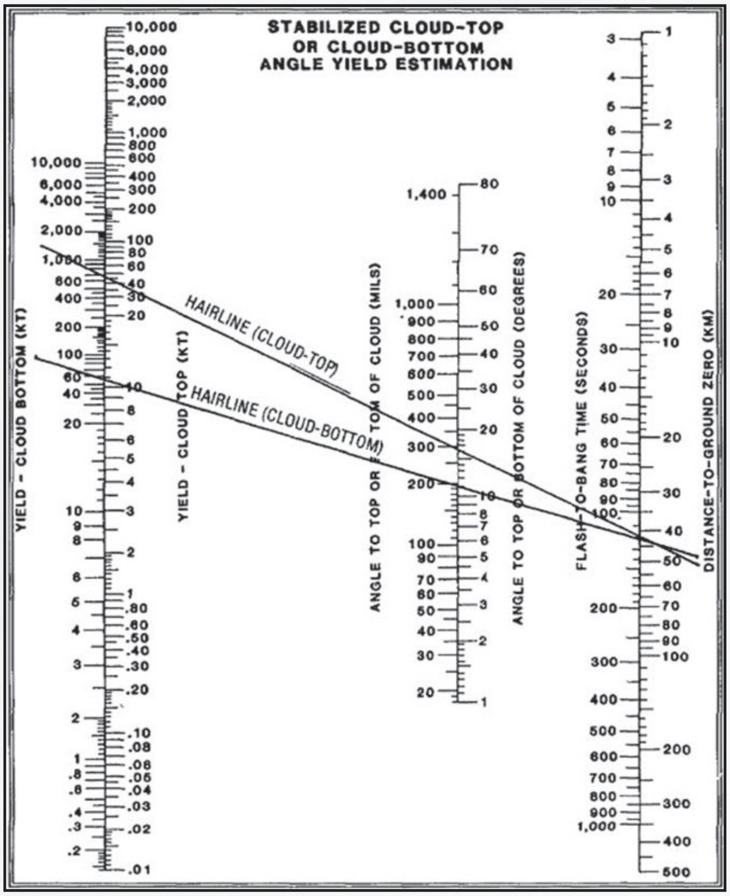
The explosive yield of a nuclear weapon is the amount of energy discharged when a nuclear weapon is detonated. The yield is usually expressed in the equivalent mass of trinitrotoluene (TNT), either in kilotons (thousands of tons) or megatons (millions of tons). Because the precise amount of energy released by TNT was (and still is) subject to measurement uncertainties, especially at the dawn of the nuclear age, the accepted convention is that 1 kT of TNT is simply defined to be 1012 calories equivalent, this being very roughly equal to the energy yield of 1,000 tons of TNT.

Scientists recognized as early as the Manhattan Project the importance of accurately assessing yield. Enrico Fermi made a (very) rough calculation of the yield of the TRINITY test by dropping small pieces of paper in the air and measuring how far they were moved by the shock wave of the explosion. Another approximation of the yield of the TRINITY test device was obtained from simple dimensional analysis, as well as British physicist G. I. Taylor's estimation of the heat capacity for very hot air. Taylor had initially done this highly classified work in mid-1941, and subsequently published a paper that included an analysis of the TRINITY data fireball when the TRINITY photographic data was declassified in 1950. Using a picture of the TRINITY test similar to those that may be obtained from the DTRIAC archives and using successive frames from the explosion, Taylor calculated that the yield was about 22 kT of TNT; a value within 10% of the official value of the bomb's yield (20 kT).

During the Cold War, commanders in the field estimated the yield of nuclear blasts using a number of DTRIAC-produced nomograph "calculators." In some instances, these calculators could be used if any of the following simple nuclear burst parameters could be estimated:

1. Distance to ground zero (or flash-to-bang time) and nuclear burst angular cloud width
2. Stabilized cloud-top or cloud-bottom height
3. Distance to ground zero (or flash-to-bang time) and stabilized cloud top or cloud-bottom angle
4. Illumination time

One example calculator is shown here, and others may be obtained from the DTRIAC.




Today, detecting atomic and thermonuclear yield is central to arms control, treaty verification, and non-proliferation. Understanding gained through prior U.S. nuclear tests helped mature two key methods currently used to determine non-U.S. weapon yields: one using seismic data and another that uses radiochemistry. Two recent examples are the North Korean nuclear tests in 2006 and 2009, in which seismic data was used to both verify that a nuclear test had taken place and to estimate the yield of each test.

The DTRIAC collection, which has data on every U.S. nuclear test (and includes data from tests conducted from some other countries), remains a valuable asset showing how the past helps us understand and prepare for the future.

# DTRIAC - Home for Weapons of Mass Destruction (WMD) Info

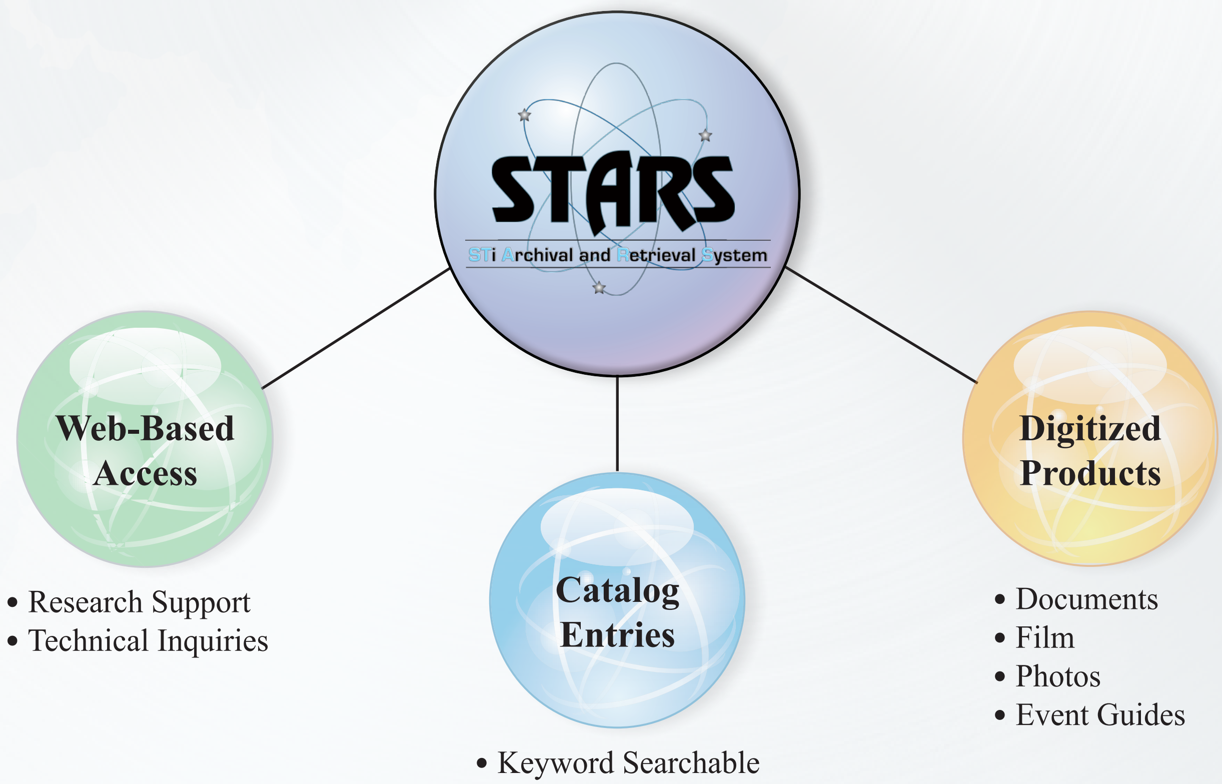
The DTRIAC acquires, digests, analyzes, evaluates, synthesizes, stores, publishes, and disseminates scientific and technical data pertaining to DTRA mission areas. These mission areas include chemical, biological, radiological, nuclear, special and conventional weapons; cooperative threat reduction; arms control treaty monitoring; on-site inspections; force protection; and counter-proliferation.

Within the scope of its charter, DTRIAC specializes in handling and providing access to nuclear weapons effects phenomenology, nuclear weapon effects educational materials, and equipment for reading and interpreting electronically recorded test data. DTRIAC's preservation and electronic access capabilities include a variety of data formats: documents, pictures, film, software, diagrams, etc.

If your organization has classified or unclassified documentation or media pertaining to one or more of DTRA's WMD mission areas, DTRIAC can host your data or provide an electronic library for your information. Your information can be held in its original form or it can be digitized and made available through a standard browser interface. Depending on your needs and the amount of data, DTRIAC can incorporate your data into the main collection for free or guide your organization through the technical area task (TAT) process to set up a specialized, stand-alone library with restricted access.

Additionally, the DTRIAC's Integrated Library System (ILS) has a sophisticated ability to restrict access using DoD distribution identifiers (Distribution A through F and X) and customizable restrictions (ITAR, CNWDI, NATO restricted, etc.). Access is protected by requiring either a government-issued identification card (e.g., CAC) or a DTRIAC-issued security token. As a result, your material can quickly be made securely accessible to anyone necessary.

If you have material that needs archiving or you need library access please contact DTRIAC at (505) 846-9448, or e-mail us at dtriac@dtra.mil.



# DTRIAC Media Archives


The DTRIAC media collection has been referred to as a national treasure; an irreplaceable asset of incalculable scientific significance and historical value. The media collection includes an extensive library of films and still photographs. This collection consists of more than 20,000 films related to nuclear weapon tests, both atmospheric, underground and underwater. Additionally, films and photos from other high-explosive test programs and more current conventional weapons effects testing at the White Sands Missile Range and the Nevada National Security Site are part of the collection.

The earliest films date from 1945, and the film formats include 70mm, 35mm, 16mm, 9x9 aerial photography from DTRA's legacy organizations, and VHS from more modern experiments. In addition to films, DTRIAC also holds approximately two million still photographs in a large range of sizes, including prints, negatives, and transparencies.

The films captured the essence of each weapon tests, revealing effects and leading to scientific discoveries that no other medium could capture at the time.

*Castle-Thermonuclaer Detonation, 1 March 1954, Marshall Islands*

In most cases, the materials in the collection are scientific in nature; i.e., they played a key role in instrumenting the tests. These films are usually silent and in black and white and are almost exclusively focused on weapon explosion phenomenology and effects. There are, however, a number of films and photographs that fall into the documentary category. These are mostly in color and include sound tracks. They typically cover a broad scope of both the pretest and posttest activities of a test series or operation. Both types have intrinsic value; for example, this collection documents a wide range of tests, at various distances and angles.

One of the biggest challenges in preserving this one-of-a-kind asset is the degradation of the films themselves. Because the early nitrate-based films were flammable, the industry moved to a cellulose acetate base. When stored in hot, humid conditions, these films begin to degrade and the degradation produces a vinegary smell, hence the term "vinegar syndrome." There is no way to halt or reverse this degradation, but it can be slowed through proper storage. DTRIAC uses acid-detection strips to test for this type of deterioration.

*Upshot-Knothole, May 25, 1953 Nevada Test Site*

*Teapot, April 15, 1955 Nevada Test Site*

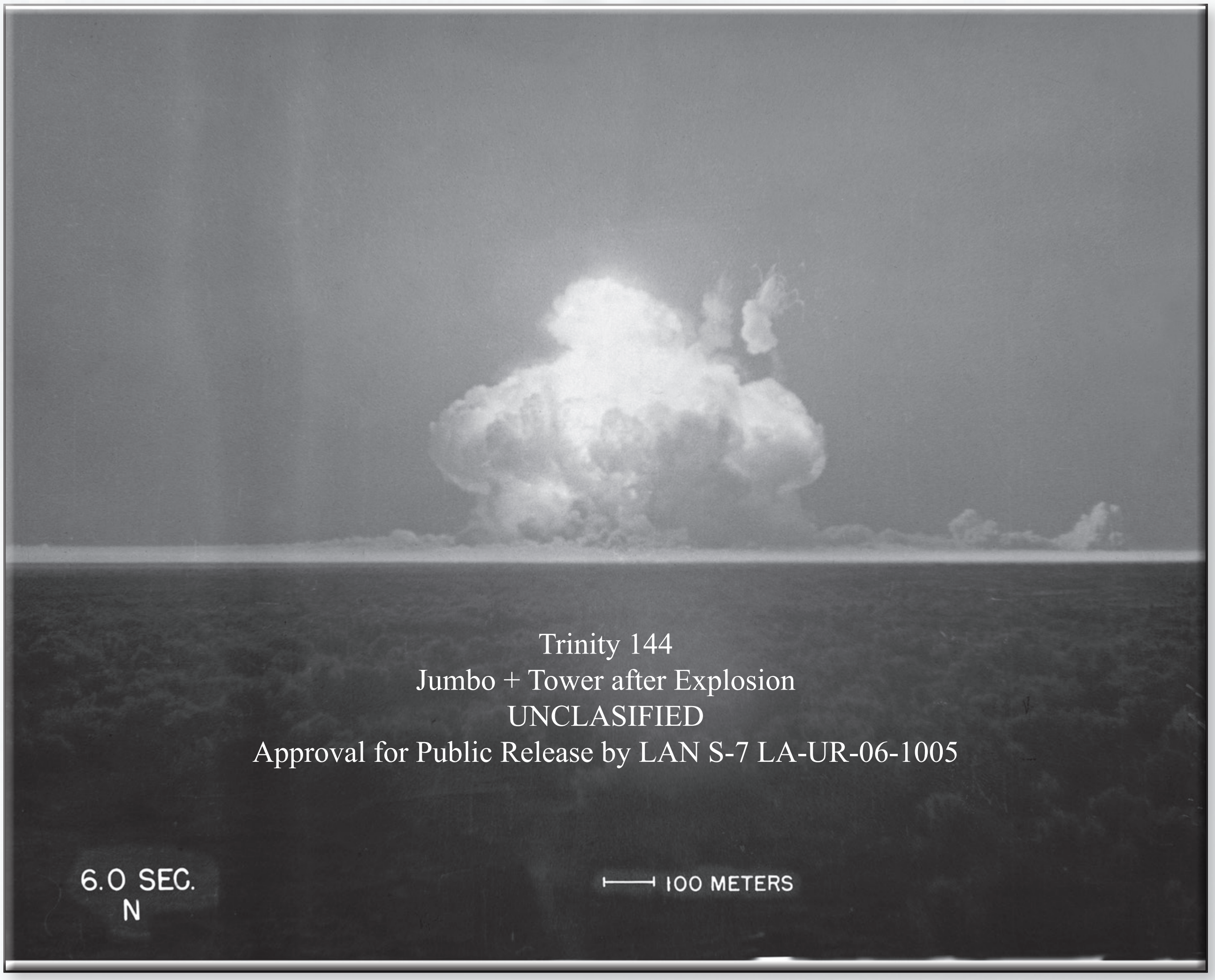
Once a film is found suspect of deterioration, it is preserved and digitized. To prevent any further deterioration to any films, DTRIAC maintains the film storage area in a controlled atmosphere at approximately 55 ºF with relative humidity between 30% and 40%.

# LLNL Film Scanning Project

During the atmospheric testing era from 1946 to 1962, the United States detonated over 200 atmospheric shots. Most of these shots were filmed by EG&G (Edgerton, Germeshausen, and Grier) to obtain scientific data relating to fireball physics, shock-wave physics, and early-time and late-time cloud behavior. The original film negatives, master positives, intermediate negatives, and projection prints for these tests are now stored in three different locations: the Los Alamos National Laboratory (LANL) Archives, the Lawrence Livermore National Laboratory (LLNL) Archives, and the Defense Threat Reduction Information and Analysis Center (DTRIAC) in Albuquerque, New Mexico.

Although every effort is being made to store and preserve these films correctly, they are made of organic material (cellulose acetate) and, as such, will eventually decompose no matter how well they are cared for. Kodak estimates that a properly stored, black-and-white film on an acetate base has a life expectancy of only approximately 100 years. Since it is unlikely that more nuclear testing will occur, preserving the scientific data and the intrinsic historical value of these films has become a priority of scientists, archivists, and historians throughout the nuclear weapon complex.

LLNL has recently begun a film-scanning project aimed at capturing and archiving the scientific data using a one-of-a-kind super-high-resolution scanner. LANL and DTRIAC have joined forces with LLNL in this endeavor. The goal is to scan the entire collection of scientific films, estimated to be up to as many as 9,000 original negatives, within the next few years. Once scanned and archived, the films, and the data extracted from the films, will be used to validate the weapons effects physics and models developed by DoD and DOE. Additionally, the project supports the National Forensics Program and other weapons effects modeling efforts. The films will be available to the rest of the nuclear weapon complex through online libraries maintained by LLNL, LANL, and DTRIAC. To facilitate this endeavor, the DTRIAC Program Manager, and LLNL have signed a formal Memorandum of Agreement to allow the temporary exchange of original films and the sharing of the scanned digital data.




Trinity 144
Jumbo + Tower after Explosion
UNCLASIFIED
Approval for Public Release by LAN S-7 LA-UR-06-1005

# DTRIAC Collection Additions

## DTRA Technical Reports

DTRA-TR-99-33, Interaction of Chemical Agents with Nanoscale Molecular Junctions
DTRA-TR-10-24, Novel Energetic Materials for Counter-WMD Applications
DTRA-TR-10-26, Personnel Radiation Exposure Associated with X-Rays Emanating from U.S. Coast Guard LORAN High-Voltage Vacuum Tube Transmitter Units
DTRA-TR-10-58, Robust Functionality and Active Data Management for Cooperative Networks in the Presence of WMD Stressors
DTRA-TR-10-59, Functional Polymer Surfaces for Binding, Sensing, and Destruction of Bioagents
DTRA-TR-11-3, Enterprise Tools for Portfolio and T2 Management, A Demonstration of Risk Analysis Investment Decision Support Plus (RAIDS+)
DTRA-TR-11-9, Integrated Adversarial Network Theory (iANT)

## DTRA Internal Reports

DTRA-IR-10-56, Nuclear Weapons Testing at the Nevada Test Site, The First Decade
DTRA-IR-10-57, Military and Civil Defense Nuclear Weapons Effects Projects Conducted at the Nevada Test Site, 1951–1958
DTRA-IR-11-5, Maritime Radiological Standoff Detection and Identification, Singapore Demonstration, Final Report, FY 2010 Measurement Campaign Technical Data Analysis

## DTRA Small Business Innovation Research

DTRIAC 74201, Systems-Agent Design Environment (Sys-ADE)

# This Quarter in History

**December 22, 1938**:
Otto Hahn and Fritz Strassman bombard uranium with neutrons and detect barium in the results. Weeks later, their colleagues, Lise Meitner and Otto Frisch, conclude that Hahn and Strassman had unknowingly split the atom, achieving nuclear fission.

**October 11, 1939**:
Alexander Sachs delivers the famous Einstein letter to President Roosevelt. The letter warned of the implications if the German researchers succeeded in developing the atomic bomb. The secret German project had started 6 months earlier.

**October 30, 1961**:
The largest, most powerful nuclear weapon ever tested, TSAR BOMBA, was detonated by the USSR as a demonstration of their technological power. At 50 MT, it was 10 times larger than all of the explosives used in World War II combined.

**November 16, 1964**:
*Capabilities of Nuclear Weapons* was first published. It was later replaced in 1972 by *Effects Manual One* (EM-1).