LA-UR-22-20970

Approved for public release; distribution is unlimited.

Title:	Building an Effective Nuclear Safety Culture
Author(s):	Schreiber, Stephen Bruce
Intended for:	NET run by ORI-1
Issued:	2022-02-04

Los Alamos NATIONAL LABORATORY

Building an Effective Nuclear Safety Culture

Steve Schreiber
Technical Deputy Director of Actinide Operations

November 2021

What is a Culture?

"A culture is a way of life of a group of people - the behaviors, beliefs, values, and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next."

- It is *not* a set of procedures or policies
- It is *not* the management flavor of the day
- It is *not* something that can be changed quickly with some "training"
- It *is* how we collectively behave (even when no one is watching) because of our shared core values
- We may have different cultures between Technical Areas, facilities, divisions, work groups, etc. so that it is important to establish a common understanding

Why Do We Need a “Nuclear Safety” Culture?

- We work in a very unique facility with “exotic” hazards
- Significant consequences could result from not following procedures and policies
  - personal radiological release or uptake
  - nuclear criticality event
  - exposure of the environment or the public to radiation sources
  - equipment/facility damage
- **Loss of the public trust**

The Battle for Public Opinion is Waged in the Media

Guest Columns

Why should anyone trust LANL on nuclear safety?

Report: Triad had serious deficiencies in first year running Los Alamos lab

Nuclear Winter May Bring a Decade of Destruction

Beyond Nuclear Fears New Mexico Being Targeted For Permanent High-Level Nuclear Waste Dump

MY VIEW

'Aura of apartheid' at LANL offers false hope

Plutonium found in glovebox during cleanup

Los Alamos REPORTER

Letter To The Editor: No Environmental Review For LANL Expansion

Secrecy News

NNSA Moves to Expand Plutonium Pit Production

DNFSB Resident Inspectors At LANL Report Waste Shipments Briefly Suspended in November

DOE Report: Los Alamos National Laboratory Mismanaged Deadly Controlled Substances

LANL's seismic safety questioned; lab says improvements are being made

Report: National laboratory lost track of nuclear waste (Associated Press)

How does this impact all of *us*?

- People are watching what happens at Los Alamos and are ready to point out our deficiencies whenever the opportunity arises
- Los Alamos provides services to the nation – our missions and funding are dependent on support from and through Congress
- Our elected officials care about public opinion
- Our livelihoods all depends not only on the Laboratory's legacy but also on our current reputation

Traits of a Healthy Nuclear Safety Culture

Established by the Institute of Nuclear Power Operators (INPO)

"We are united in our pursuit of excellence through a commitment to these values:

- Trusting **Relationships**
- Impeccable **Integrity**
- Influential **People**
- Unwavering **Standards**
- Responsible **Stewardship**
- Innovative **Improvement**"

Mission

To solve national security challenges through simultaneous excellence.

Vision

To be trusted by our nation, emulated by our peers, and respected by the world.

Culture

How we do work is as important as *what* we do.

ALDWP

VALUES & BEHAVIORS

***How* we do work is as important as *what* we do.**

VALUES

Commitment
We are dedicated to successfully meeting the Laboratory nuclear security mission and associated deliverables demonstrating a shared commitment while exceeding the expectations of customers, partners, and colleagues.

Respect
We will value differences and encourage every team member to express themselves in order to work together toward common goals. We demonstrate high regard for customers, partners and colleagues as we work to meet to serve our Nation and Community.

Integrity
We will maintain high ethical standards. We are honest and fair in all aspects of our work. We fulfill our obligations as responsible employees and stewards of the taxpayer's dollar. We value our personal reputation and the reputation of the organization. We recognize that our integrity can impact national security.

Dealing With Problems
We will anticipate, identify, acknowledge and take initiative to understand the root cause and solve problems. We acknowledge and learn from our mistakes without assigning blame. We help others to solve problems and will be responsible and accountable for our actions.

Taking Care Of People
We will recognize and value each person and continuously look out for one another through respectful behavior and safe work practices to achieve the success of the individual, the Institution and the mission

Precision In Language
We will take the time to formulate our thoughts before speaking and writing to accurately convey our message. We will maintain respectful language and approach in all interactions.

BEHAVIORS

Personal Responsibility
We will have the courage to hold ourselves accountable and behave in a professional manner demonstrating integrity, ethics and a high standard of values. We will demonstrate discipline while maintaining a questioning attitude.

Value The Legacy
We will respect the contributions of the past. In addition, we will actively seek the knowledge and expertise of team members. We will share our collective knowledge to foster growth among individuals and across the greater organization.

Raise Concerns
We will create a safe environment in which concerns can be raised without fear of reprisal. We will address problems, staff concerns, organizational obstacles and difficult situations respectfully and directly in a timely manner.

Continuous Learning
We will proactively develop, adapt and transform ourselves through a mindset of continuous learning and share those lessons with others. We will assess risks and emerging challenges to ensure they are addressed appropriately through a framework of informed perspectives.

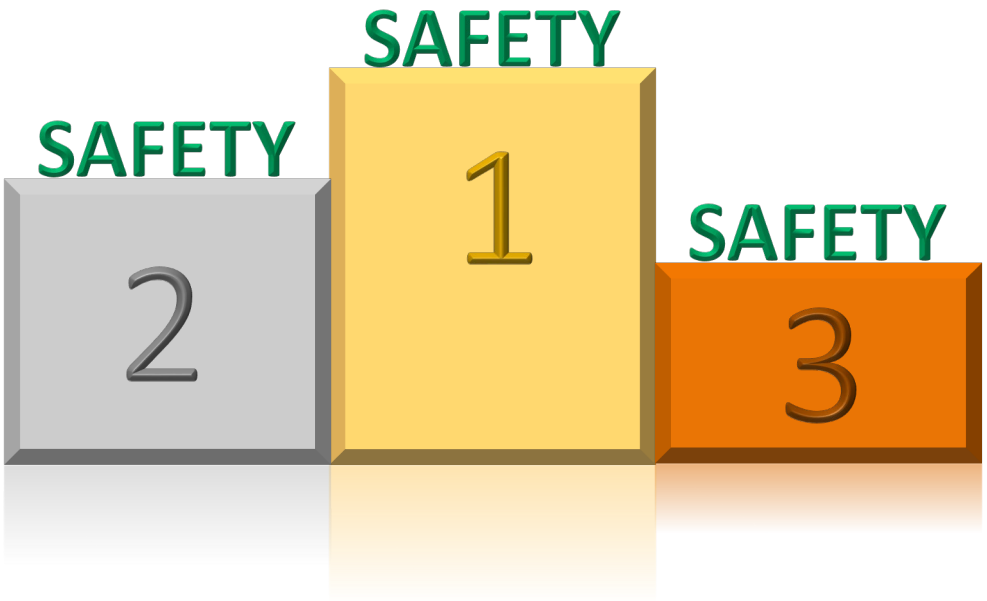
Continuous Improvement
We will challenge the status quo, consider new ideas from anywhere and never become complacent with success. We will empower each other to take measured risk to solve problems and continuously improve.

Los Alamos NATIONAL LABORATORY

LANL Safety Policy

- “We make safety and security integral to everything we do.”

- Safety is not more important than the work we get paid to perform in the national interest, but it is a requisite and imbedded part of successfully getting the job done



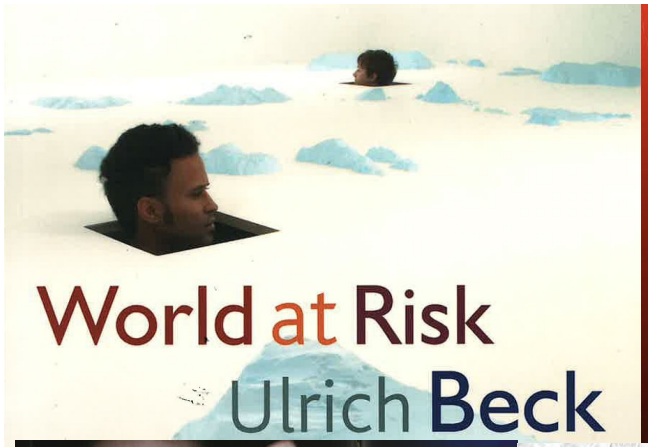
Risk and Safety

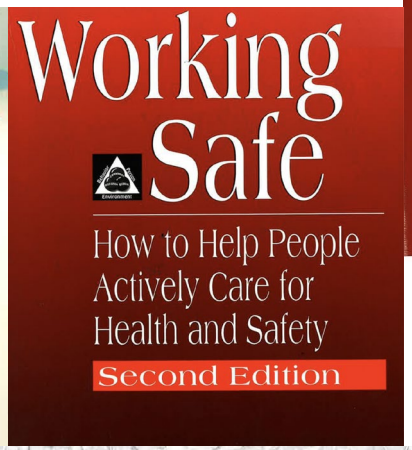
- Safety and risk are two sides of the same coin
- Just to avoid all risk is not necessarily to be safe
- Managing safety and risk is not “black or white” but varying shades of grey

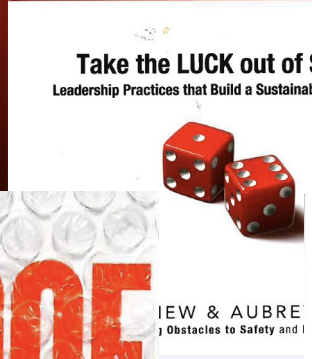
How do we deal with Risk?

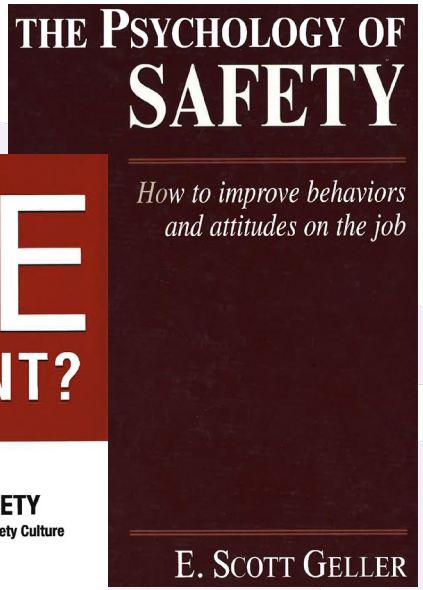
- Risk in general
- Risk management in the Nuclear Weapons Complex
- Risk in historical perspective
- Consequences of risk management and the impacts on safety
- Establishing an effective Nuclear Safety Culture

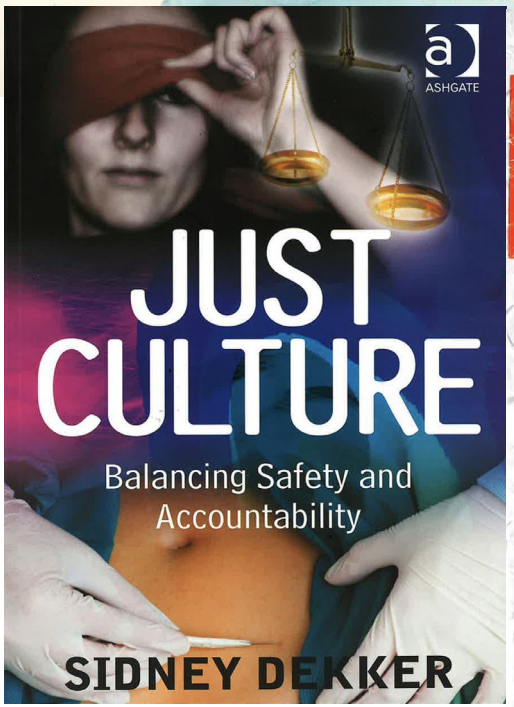
Selected Relevant References

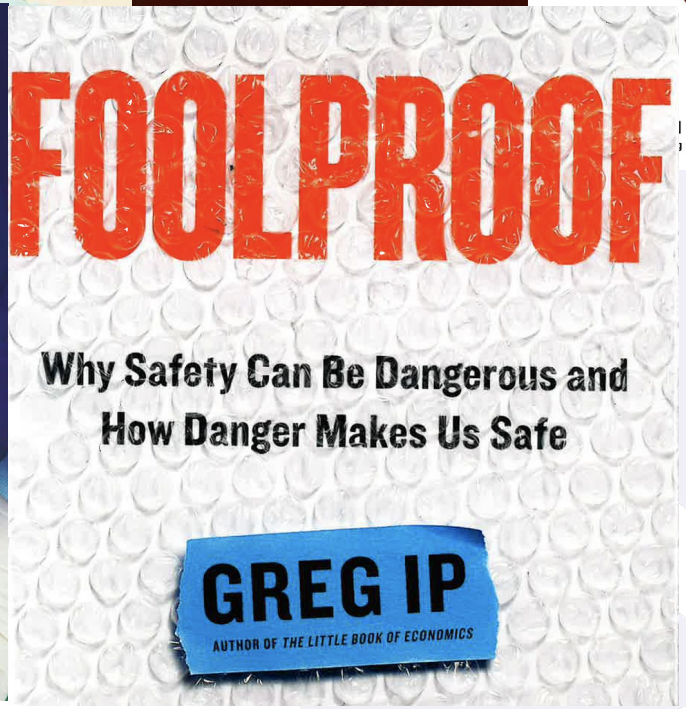


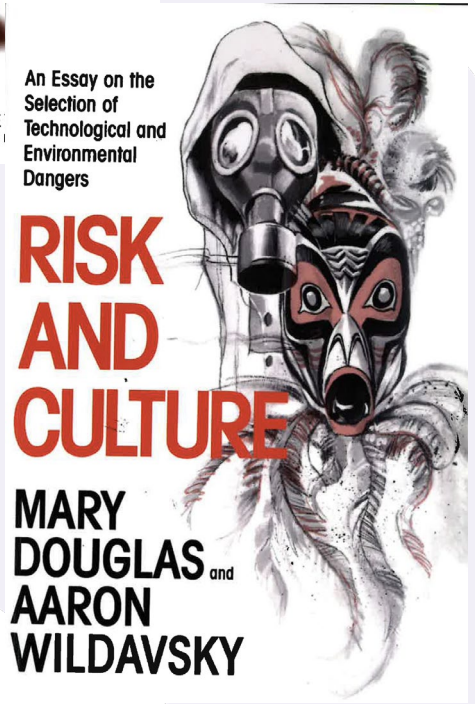












Risk (definitions)

- Per the dictionary - the chance of death before our allotted time
- In the insurance industry – the product of the probability and the value of the loss
- In the Department of Energy (DOE Guide 413.3-7A) – the product of the probability and the consequence (on both the cost and the schedule)

Management of Risk

- Regulation by appropriate independent organizations is the preferred approach to managing technological risk
- In the United States (snapshot as of 1992)

Occupational Safety and Health (OSHA) of the Department of Labor; Consumer Product Safety Commission (CPSC); Environmental Protection Agency (EPA) with offices devoted to water, air, wastes, pesticides, radiation, etc.; Food and Drug Administration (FDA) of Department of Health and Human Services; Nuclear Regulatory Commission (NRC); Federal Emergency Management Agency (FEMA); Bureau of Alcohol, Tobacco, and Firearms (ATF) of the Treasury Department; Mine Safety and Health Administration (MSHA) of the Department of Labor; National Highway Transportation Safety Administration (NHTSA) of the Department of Transportation; Federal Aviation Administration (FAA) of the Department of Transportation along with the National Transportation Safety Board (NTSB) an independent agency; Drug Enforcement Administration (DEA) of the Department of Justice; Cost Guard (USCG) of the Department of Transportation; and the Defense Nuclear Facilities Safety Board (DNFSB).

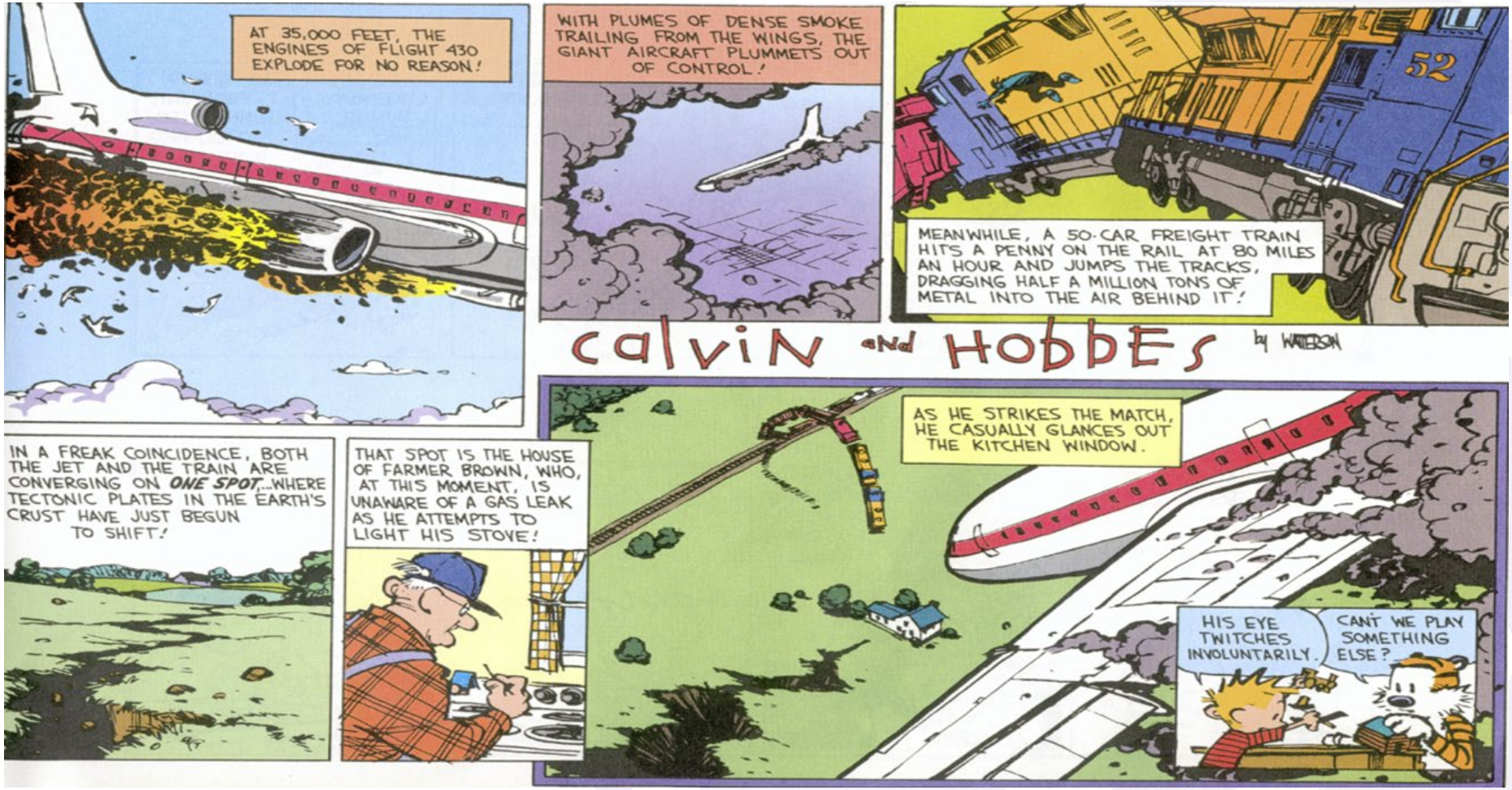
Managing Risk by Anticipation or Resilience

- The number and magnitude of hypothetical harms are limitless which makes significant expenditures on them challenging
- Finite or limited resources used to address such postulated risks or “black swan events” are not available for attaining other goals, goals which indirectly may also lower risks and make us safer
- In hindsight after any event, it is usually apparent how it could have and thus should have been prevented, but it is also the tendency to forget how many hazards that were predicted never came to pass
- **Example**: At LANL the Plutonium Facility (PF-4) in response to an updated Design Basis Accident, seismic upgrades were performed, primarily the addition of a drag strut across the roof, as part of $33M invested in the then 33 year-old structure

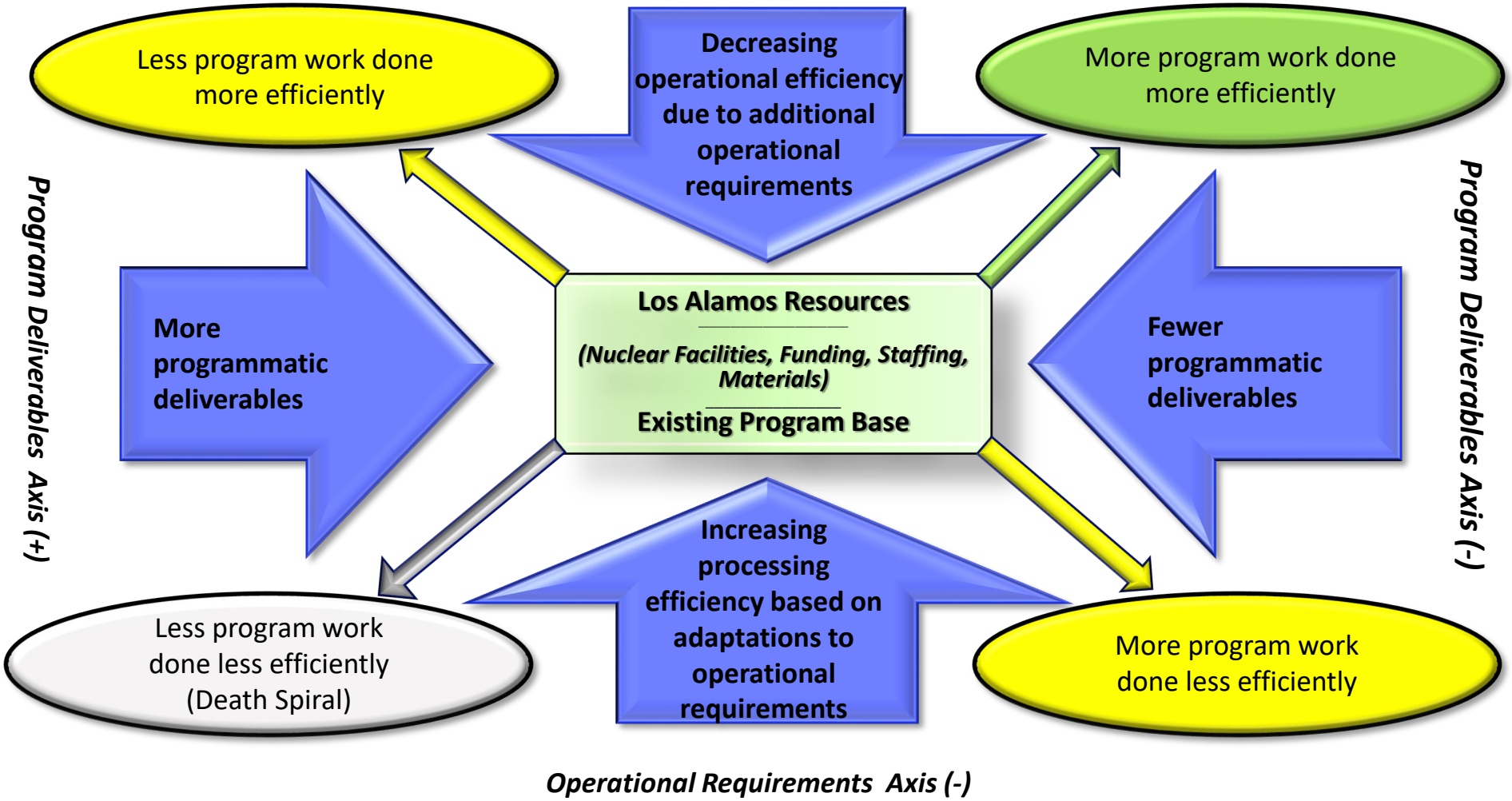
References: ***Searching for Safety*** (1982) and ***Risk and Culture*** (1988) by Aaron Wildavsky

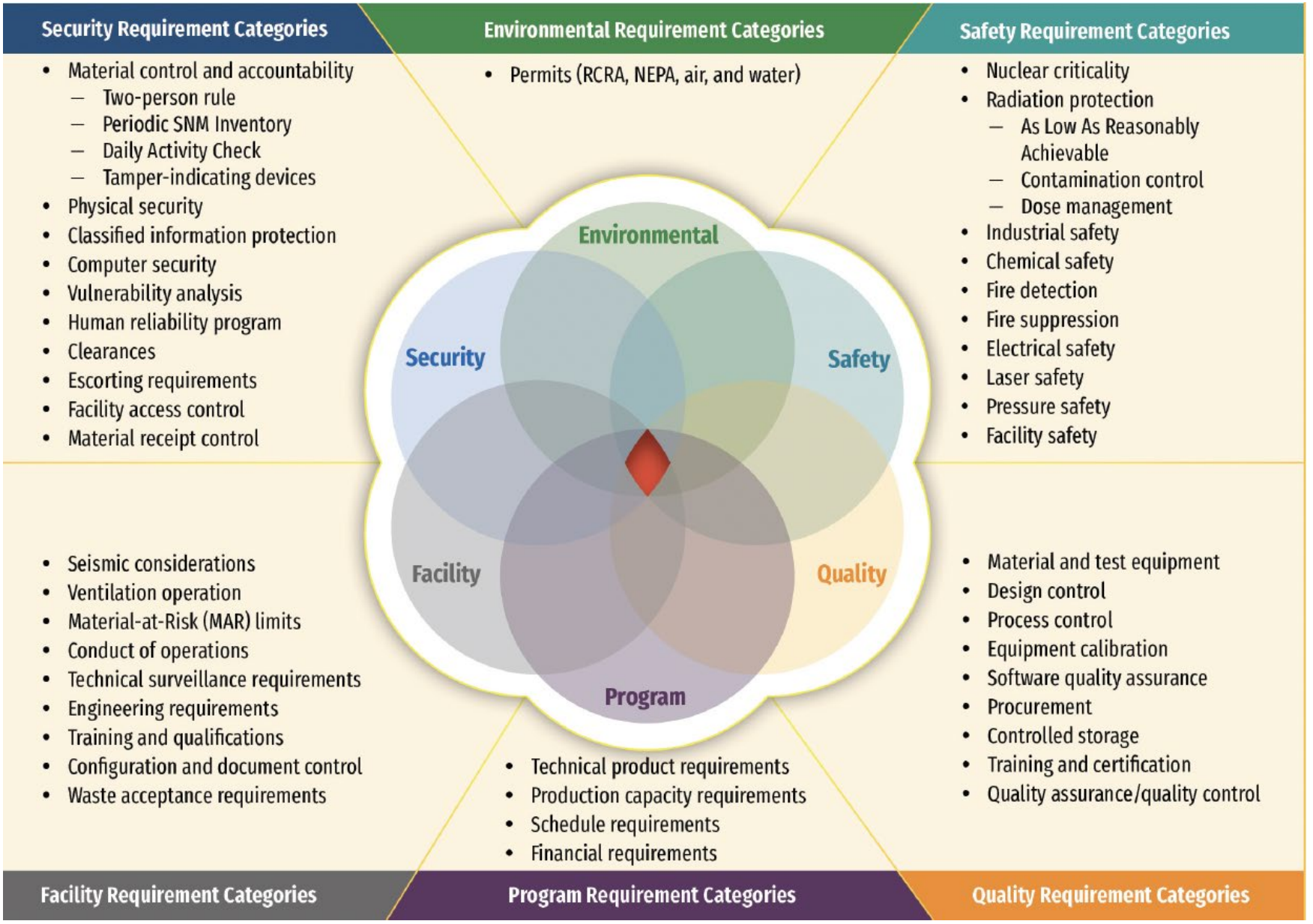
LANL – Plutonium Facility Seismic Upgrade 2011

Risk in the Modern World



Program Deliverables vs Operational Requirements





Nuclear Safety Culture lies at the intersection of all the requirements, for example:
Security Category 1, Hazard Category 2 Nuclear Materials Handling and Processing Facility (PF-4)

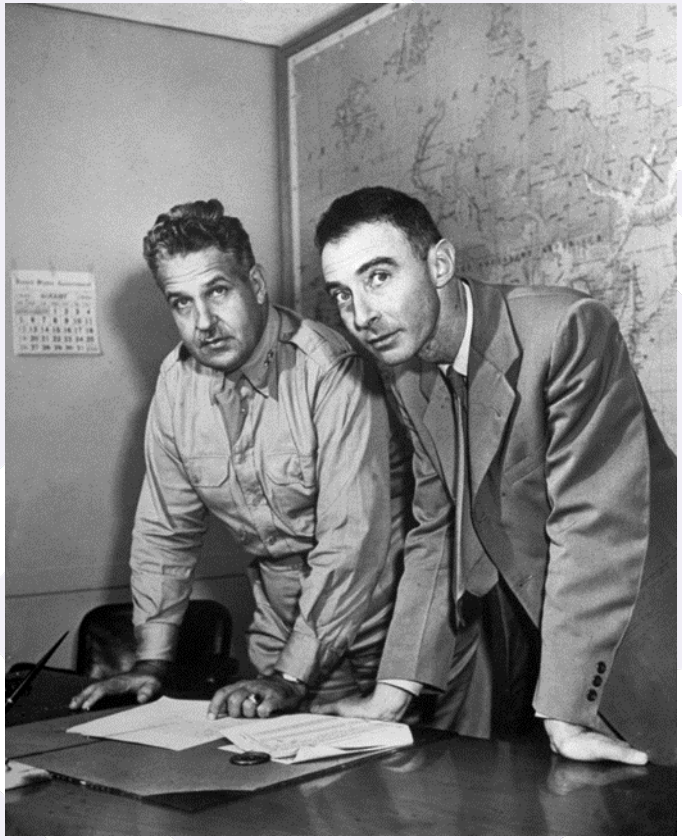
WWII Era Safety Message

PLATE 6 A cartoon distributed at Manhattan Project sites during 1944. The purpose of the image, according to General Leslie R. Groves, was "to impress on all concerned the necessity of making decisions promptly and that a 'safety first' policy would insure defeat." Correspondence and Related Papers on the MED, 1942–70, Papers of General Leslie R. Groves, National Archives and Records Administration.

WWII Era Safety Message

"Each employee can do more to protect himself and his fellow workers than all the rules in the world, and it is of utmost importance that each of us feel at all times the responsibility of safeguarding himself and others."

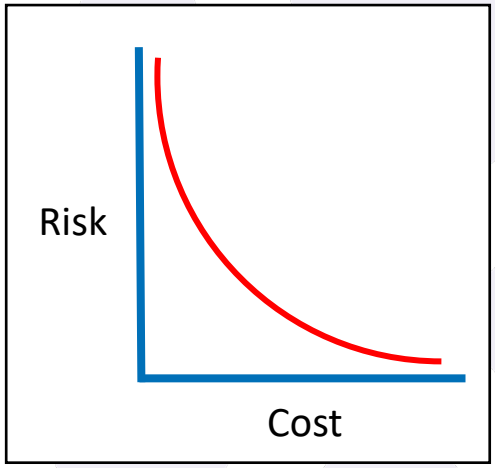
- *J. Robert Oppenheimer,*
  Los Alamos Laboratory Director, 1945



General Leslie R. Groves J. Robert Oppenheimer

Risk Management

- In the field of safety, there exists a law of diminishing returns
- If one attempts to eliminate all risk, the cost increases exponentially
- Notional asymptotic curve (probably logarithmic) plotting risk avoidance vs. costs, never achieve zero risk even at infinite expense



Objective becomes to achieve a manageable and affordable balance (even a local optimum) allowing for work to be *successfully* accomplished

Preparing for Only the Worst

- Workers must prepare for all relevant and foreseeable events, not just for only the worst conceivable, or else they will be less well prepared for those that are more likely

- Worst-case fixation leads to failure in the better-than-worst world
  - Finding the worst-case in any *realistic* scenario is difficult, perhaps even impossibly so
  - Risk must consider the likelihood or probability of the anticipated events or else it is just speculative consequence
  - It is pervasive to assume that if the worst-case is covered, everything else is too

"Conceivable" is not the same as "credible"

Balance within Safety Culture

Worker safety entails addressing a variety of hazards, some unique to nuclear process operations, but many more that are general.

- **Asbestos**
- **Chemicals and toxic materials**
- **Confined spaces**
- **Cryogenics**
- **Electrical**
- **Ergonomics**
- **Fire**
- **Firearms**
- **Hearing conservation**
- **Ionizing radiation**
- **Machine tools**
- **Non-ionizing radiation**
- **Nuclear criticality**
- **Pressure**
- **Radioactive contamination**
- **Rigging and lifting**
- **Stored energy**
- **Thermal**
- **Traffic and vehicles**
- **Walking and working surfaces**

Safe Conduct of Research (SCoR) Principles

1) Everyone is personally responsible for ensuring safe operations
2) Leaders value the safety legacy they create in their discipline
3) Staff raise safety concerns because trust permeates the organization
4) Cutting-edge science requires cutting-edge safety
5) A questioning attitude is cultivated
6) Learning never stops
7) Hazards are identified and evaluated for every task, every time
8) A healthy respect is maintained for what can go wrong

SCoR Principles in Practice

- “When everyone is in charge, no one is in charge” is the risk from too many reviews and approvals before any work can be performed
- Procedures capture and transmit historical operating experience
- Procedures are reviewed by numerous appropriate Subject Matter Experts (SMEs) to identify, mitigate and minimize job hazards
- Procedures *cannot* do away with individual responsibility, thus decision making must be transferred from words on a page back to the workers on the job site
- Clear roles and responsibilities seamlessly integrated with authority and accountability (R2A2) are essential to have an effective work team, starting with a designated and recognized Person In Charge (PIC)
- “Measure twice, cut once” or “short cuts make long delays”
- Well-trained, knowledgeable and engaged workers are ultimately responsible for themselves and their teammates

Managing Risk Evolves to Improve Safety

- **Example:** PF-4 safe haven activities, maintain worker productivity by minimizing exits from the facility for breaks by providing ”refreshments” in the hallways
- **Example:** PF-4 “Red Light” activities, allow for glovebox process work to take place in the same room at the same time as glovebox maintenance work, i.e. routine glove changes
- **Example:** PF-4 radiation monitoring techniques and technology improvements, RCTs performing Anti-C monitoring were replaced with more sensitive and standardized HFM-8 and PCM-2 units, alpha probes were placed at all glovebox work stations and later upgraded with wireless and source-less units
- **Example:** Real-time external dosimetry to provide immediate feedback and thus reduce radiation exposures for workers in high-radiation areas such as the PF-4 vault and handling isotopes such as Pu-238

Managing Risk by Identifying Competing Hazards

- **Example:** LANL 2003 “Five Worker” event at the Plutonium Facility

Five employees hospitalized after exposure to toxic vapors

SCoR Principles within Nuclear Safety Culture

- Safety is a balancing act between multiple competing requirements and objectives
- View safety as an evolutionary process rather than as a permanent condition because there is no stable optimum and there is always room for improvement
- Safety must be continuously re-accomplished or it will decline, but this may not be known until some bad event highlights it, so we must continuously learn from *all* events that deviate from expectation
- Safety requires ongoing vigilance to avoid becoming complacent with past successes
- Safety is always relative since being safer than we *used* to be does not mean being as safe as we *might* be

ALDWP
VALUES & BEHAVIORS

***How* we do work is as important as *what* we do.**

VALUES

Commitment
We are dedicated to successfully meeting the Laboratory nuclear security mission and associated deliverables demonstrating a shared commitment while exceeding the expectations of customers, partners, and colleagues.

Respect
We will value differences and encourage every team member to express themselves in order to work together toward common goals. We demonstrate high regard for customers, partners and colleagues as we work to meet to serve our Nation and Community.

Integrity
We will maintain high ethical standards. We are honest and fair in all aspects of our work. We fulfill our obligations as responsible employees and stewards of the taxpayer's dollar. We value our personal reputation and the reputation of the organization. We recognize that our integrity can impact national security.

Dealing With Problems
We will anticipate, identify, acknowledge and take initiative to understand the root cause and solve problems. We acknowledge and learn from our mistakes without assigning blame. We help others to solve problems and will be responsible and accountable for our actions.

Taking Care Of People
We will recognize and value each person and continuously look out for one another through respectful behavior and safe work practices to achieve the success of the individual, the Institution and the mission

Precision In Language
We will take the time to formulate our thoughts before speaking and writing to accurately convey our message. We will maintain respectful language and approach in all interactions.

BEHAVIORS

Personal Responsibility
We will have the courage to hold ourselves accountable and behave in a professional manner demonstrating integrity, ethics and a high standard of values. We will demonstrate discipline while maintaining a questioning attitude.

Value The Legacy
We will respect the contributions of the past. In addition, we will actively seek the knowledge and expertise of team members. We will share our collective knowledge to foster growth among individuals and across the greater organization.

Raise Concerns
We will create a safe environment in which concerns can be raised without fear of reprisal. We will address problems, staff concerns, organizational obstacles and difficult situations respectfully and directly in a timely manner.

Continuous Learning
We will proactively develop, adapt and transform ourselves through a mindset of continuous learning and share those lessons with others. We will assess risks and emerging challenges to ensure they are addressed appropriately through a framework of informed perspectives.

Continuous Improvement
We will challenge the status quo, consider new ideas from anywhere and never become complacent with success. We will empower each other to take measured risk to solve problems and continuously improve.

Los Alamos NATIONAL LABORATORY


CAUTION
THIS SIGN HAS
SHARP EDGES
DO NOT TOUCH THE EDGES OF THIS SIGN
ALSO, THE BRIDGE IS OUT AHEAD