

**"Past as Prologue:
Are there Lessons to be Learned from the
Nuclear Physics and Cryptography Communities?"**

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Science at Los Alamos

- **Los Alamos is a national defense laboratory with three primary missions:**
 - **Stewardship of the nation's nuclear stockpile**
 - **Responding to threats of weapons of mass destruction**
 - **Responding to the nation's energy and environmental needs**
- **Basic and applied research and engineering underpin the Laboratory's ability to respond to our missions**
 - **~ 60% of the research at Los Alamos is very applied**
 - **Modeling the performance of nuclear weapons**
 - **~ 40% of the research is very fundamental**
 - **Search for the origin of time reversal violation**
 - **Many groups do a mix of basic and programmatic research**

Free and open exchange of unclassified information is a hallmark of the science at LANL.

Representative Cases

- **Nuclear Physics Research**

- The majority of nuclear physics research is unclassified and often involves large collaborations with several participating countries.
- **A relatively small fraction of the experiments and theory generate dual-use information.**
 - In the absence of nuclear testing, we need to develop accurate *ab initio* calculations of nuclear weapons performance.
 - This requires improved measurements and calculations of cross sections that are of relevance in nuclear weapons.
 - Many of these cross-sections are also relevant to nuclear astrophysics.
 - In response to homeland defense needs, we need novel capabilities to detect nuclear materials.
 - We are adapting detector technologies used in rare-process, low-background experiments to detect highly enriched U and Pu.

Representative Cases

- **Quantum Cryptography (QKD) and Quantum Computation (QC) Research**
 - The underlying concepts and technology that enable QKD and QC are generally unclassified.
 - **The QKD effort at LANL is closely tied to the QC effort.**
 - Both rely on the ability to use isolated quantum-mechanical states.
 - Virtually all of the techniques developed are dual-use.
 - QKD is of great interest to industrial and financial companies.
 - QKD is also of great interest to the Intelligence Community as a means of communication that cannot be subverted.
 - QC is of interest in the development of quantum-mechanical techniques and applications in computer science.
 - QC is also of great interest as a dramatic increase in the ability to factor numbers - an important asset in code breaking.

Issues in Representative Cases

- **There are two classes of information that must be handled**
 - **Data that has dual-use applications**
 - **eg., nuclear physics cross sections**
 - **Techniques and equipment that have dual-use applications**
 - **eg., quantum cryptographic equipment**
- **In both cases, much of the data, techniques, and equipment are dual-use but become restricted to single-use in particular applications.**
 - **In nuclear physics, it is the incorporation of the data into models of nuclear weapons that makes it restricted information.**
 - **In homeland defense, it is the specific sensitivity and deployment of sensors that makes it restricted information.**
 - **In QKD, it is the application to specific cases and adaptations of equipment and techniques to those cases that make it restricted.**
- **Different classification levels exist for different elements**

Issues in Publication and Presentation

- **Two paths for publication and presentation of research**
 - **Research is in an area that falls within the specified subjects in a Designated Unclassified Research Area (DUSA)**
 - *DUSAs are standing NNSA approved exceptions of specified research areas*
 - *eg., cosmology, high energy neutrino physics, ...*
 - **Papers and talks are reviewed and approved for publication by an Authorized Derivative Classifier (ADC)**

Every LANL publication and public presentation goes through this process.

Issues in Mail and Email Communication

- **Individuals are trained to recognize classified material and then charged with the responsibility to ensure content in emails is not classified.**
 - **If uncertain, email message is checked by ADC prior to being sent.**
 - **Email from people working on classified programs contains a statement about the classification level.**
- **Most problems that arise fall into three categories:**
 - **Content that may be classified was sent without ADC review.**
 - **Classification level was incorrectly determined.**
 - **Sequence of emails taken together is classified even though individual emails were not classified.**
 - **The last two are significant problems:**
 - *It is impossible to detail the guidance sufficiently to provide explicit classification for all cases.*
 - *It is very easy to include some new piece of information in an email chain without carefully checking all of the other content.*

Communication Issues within Groups

- **Almost all LANL groups have both cleared and uncleared personnel.**
- **Many groups have foreign nationals as staff, postdocs, or students.**
- **This results in the inability to discuss some aspects of the research within the group with all group members.**
 - **This requires continuous awareness of what is being discussed.**
 - *This has occasionally been an issue, but has not proven to be a fundamental problem.*

Communication Issues with External Groups

- **Most of the interactions of LANL staff with external institutions deal with open R&D.**
 - This does not raise any additional concerns, although collaborative work needs to be approved by management.
 - There is a separate issue with open communications with people from sensitive countries.
 - All such interactions must be reported to LANL security.
- **Classified R&D requires special means of communication:**
 - Secure phones, faxes
 - Secure computer networks
 - Secure libraries housing classified information

Communication and Physical Separation

- **Work on dual-use technologies can normally be done in open, unclassified environments.**
 - **Nuclear physics research is normally done at open user facilities**
 - **Specific experiments (eg., with Pu) require setting up an exclusion area that has physical security (fences, locked doors, surveillance, ...)**
 - **Staff typically has offices in open, unsecured areas but have access to offices and systems (xerox, computing, printing, ...) in classified areas.**
 - **In a number of cases, part of the group has offices inside a security area and part of the group has nearby offices in an open area.**
 - **QKD is carried out in a SCIF (Sensitive Compartmented Information Facility) while QC is carried out in an adjacent open building.**
 - ***This limits communication - not all people in the group have clearances so those who do have to come out from behind the fence to meet with other group members.***

Communication with Foreign Nationals

- **All communication that involves foreign nationals requires security oversight and verification.**
 - **At Los Alamos, all foreign nationals must be approved.**
 - **Approval includes designated mentor , work description, buildings that can be visited, computer systems that can be accessed.**
 - **Meetings that involve foreign nationals must be approved in advance.**
 - **Foreign national assignments are reviewed each year to ensure no inappropriate information or technologies have been shared.**
- **Restrictions are continuously becoming more stringent.**
 - **Any interaction with foreign nationals that involves dual-use technology becomes an export control issue.**
- *These issues have lead to issues with foreign nationals:*
 - *Limited access to facilities and information.*
 - *Difficulty in doing certain aspects of their job.*
 - *Increased possibility of security violations.*
 - *Feelings of discrimination - being a second-class citizen.*

Lessons Learned

- **The bioscience community will have to deal with the increasing rigor that is being focused on national security issues.**
- **Dual-use R&D necessarily engenders additional efforts:**
 - **Review process for all publications and presentations.**
 - **Mail and email exchanges must be monitored.**
 - **Awareness in discussions with internal and external personnel.**
 - **Provision for infrastructure for sensitive communications.**
- **Physical access restrictions create barriers to communication**
 - **eg., BSL facilities, activities involving the Intelligence Community**
- **Foreign nationals present a unique challenge in dual-use R&D.**
 - **Export controls on dual-use R&D are a serious concern at universities.**
- **Recommendation: Form integrated teams (science and compliance personnel) to develop solutions to these issues.**