The Los Alamos Universe

Using multimedia to promote Laboratory capabilities

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Prepared by

University of Washington
Seattle, Washington

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THE LOS ALAMOS UNIVERSE

This project consists of a multimedia presentation that explains the technological capabilities of Los Alamos National Laboratory. It takes the form of a human-computer interface built around the metaphor of the universe. The project is intended to promote Laboratory capabilities to a wide audience.

Multimedia is simply a means of communicating information through a diverse set of tools—be they text, sound, animation, video, etc. Likewise, Los Alamos National Laboratory is a collection of diverse technologies, projects, and people. Given the ample material available at the Laboratory, there are tangible benefits to be gained by communicating across media.

This paper consists of three parts. The first section provides some basic information about the Laboratory, its mission, and its needs. The second section introduces this multimedia presentation and the metaphor it is based on along with some basic concepts of color and user interaction used in the building of this project. The final section covers construction of the project, pitfalls, and future improvements.

The Laboratory - Some Basic Facts

Los Alamos is one of nine national laboratories scattered across the country. Of these nine, three laboratories (including Los Alamos) are responsible for weapons design and testing—the other two being Sandia National Laboratories and Lawrence Livermore National Lab. Los Alamos has about 6,800 employees spread across 27 divisions and programs (18 technical). Since its formation in 1943, the Laboratory has been operated for the Department of Energy by the University of California. The primary mission of the Laboratory has always been national defense. As birthplace of the atomic bomb, the Laboratory has been on the forefront of weapons development and the application of basic research to defense needs.

The primary mission of the Laboratory remains essentially unchanged, but has taken on broader implications. The new mission “reducing the nuclear danger” is a combination of old responsibilities with responsibilities that emerge from the new world order. Just because the cold war is history doesn’t mean that nuclear weapons will suddenly disappear overnight. Rather than building new weapons, the Laboratory’s primary concern is the maintenance and safe storage of the weapons currently in the stockpile. This “cradle-to-grave” approach is complemented by an increased effort to stop the spread of nuclear weapons and radioactive material throughout the world. This new mission also encompasses the environmental impact and cleanup of more than 50 years of weapons production and testing.
Despite the apparent single-minded nature of the Laboratory, its defense programs have also driven much of the development in modern electronics and computing. These efforts have led to beneficial impacts for communications technology and electronic test equipment. In addition to its defense mission, the Laboratory has made a significant impact in applying defense technologies to industrial and civilian problems. The most significant development has been the rapid increase in environmental research and funding, which now exceeds defense spending for the first time.

Since the end of the cold war and due to the policies of the Bush and Clinton administrations, the Laboratory has stepped up promotion of its technology as a means of solving complex industrial and civilian problems. As a result of this increased promotion (otherwise known as the dreaded “m” word—marketing), the Laboratory has had to reach out to potential audiences that it may never of had a lot of contact with, or had interacted with only in a more informal manner.

The Problem

As a technical facility, Los Alamos National Laboratory faces some interesting obstacles to communicating information. The first obstacle is the historical need for secrecy and the remoteness of the Laboratory. In a world filled with modern transportation and communication technologies, the Laboratory is, for all intents and purposes, still relatively isolated. Los Alamos wasn’t even considered an open town until 1957. All these factors have created an intense desire to guard information, which conflicts with directives to be more open and collaborative.

Another obstacle is targeting specific audiences for Laboratory information. This seemingly simple task presents a challenge because the audience for the Laboratory information consists of a number of different groups with varying interests.

- Political entities - Congress, the White House, the Department of Energy Headquarters, other national labs and government agencies;
- Public entities - interest groups, local citizens and ethnic groups, concerned businesses, and the media;
- Professional entities - industry, universities, small business, and potential collaborators.
Each audience has its own needs, level of understanding, and tolerance factor when it comes to dealing with complex information. In addition to the different types of audiences, the Laboratory is often subject to political whims and the budgetary ebb and flow. These forces can impact which projects are important and receive funding, and what information needs to be communicated.

The Laboratory has a number of different ways to meet the demands for information and inform interested groups about Laboratory activities. The initial line of "defense" is the Public Affairs Office at the Laboratory. This office handles all queries from the mass media, addresses concerns from the public and surrounding communities, and organizes visits and escorts officials and corporate representatives. Industrial and commercial queries are handled by the Industrial Partnership Office. All other Laboratory communications, such as reports and presentations, go through a central writing and editing group.

Considering the various groups the Laboratory needs to reach, what is would be helpful is a unified approach to presenting the diverse information about the Laboratory. This multimedia project has been an initial experiment in unifying technical information about the Laboratory and promoting its capabilities.

The Metaphor - Why the Universe?

I expended a lot of energy trying to find a way to present information about the Laboratory in a compelling and useful manner. The structure of the information is hierarchical but great pains were taken to avoid a push-button, menu-driven, Windows-like, BORING, interface. This effort was complicated by that fact that the Laboratory does so many different things. For a while, a screen listing the letters of the alphabet was starting to look like a good interface.

My interest in astronomy started me thinking about how scientists have managed to catalog and organize the structures within the universe. Then it hit me, why not just map the information about Los Alamos to the universe—the biggest, non-boring hierarchy I could find.

There are three big advantages to using an astronomical/space metaphor to communicate information about Los Alamos. The first is the broad appeal of space and science fiction. The second is that this metaphor is infinitely extensible. The third advantage is that the metaphor is highly flexible when it comes to presenting the information.
Broad Appeal

The popularity of astronomy and science fiction offers a lot of possibilities when trying to promote new technologies. Many people have at one time peered through the eyepiece of a telescope, looked up at the night sky to view the constellations, or wished upon a star. Those who haven’t made it outside have at the very least seen one episode of Star Trek or read a science fiction book. The point: stars are familiar. Astronomy and space also appeal to younger audiences as evidenced by typical Saturday morning cartoons.

Another way to look at the appeal of space is that almost everyone knows what NASA does or has heard Neil Armstrong’s famous first line from the moon. I’d argue that most people are not as familiar with what Los Alamos has accomplished even though it is as historically significant. Not all of this is the fault of bad communication from the Laboratory. As mentioned before, the need for secrecy has a tendency to suppress the interesting developments in technology. However, if the lure of space can get even one person to explore the CD, then that is one more person who knows about the Laboratory and what it does.

Extensible

The second advantage is that the metaphor is very extensible and can support a variety of topics and still not “break.” The universe at large provides a lot of different objects to map information to and it can be organized in a number of different ways. For example, related examples can be linked in constellations, or inter-laboratory collaborations can be represented by nebulae. As the collaboration fosters new projects, new stars can form in the nebulae, just as they do in space. Short-term or special projects might be represented by comets or asteroids. The choices and possibilities are endless.

Flexible Delivery

The space metaphor can be carried across a number of different platforms and can be tailored to suit the specific delivery advantages of each method. For example, the project can be easily adapted for use on the Internet as series of clickable image maps. A further possibility is that with enough time and money, the concept can become a full-blown 3-D virtual environment and one could “fly” between the stars. As Tufte states,

Escaping this flatland [of paper and computers] is the essential task of envisioning information—for all the interesting worlds (physical, biological, imaginary, human) that we seek to understand are inevitably and happily multivariate in nature. Not flatlands. (Tufte, 1990)

Using other methods of delivery opens up the possibilities for communicating with a broader audience in a manner more useful to the reader.
The Structure of the Universe

While the underlying structure for the project is a hierarchical network, there are a number of links and ways to navigate between levels. For this project the "universe" consists of sectors, stars, and planets. Other astronomical features have been reserved for later use.

The "universe" consists of four basic levels. A primary goal of the interface has been to minimize how deep a user needs to go to get useful information.

- **First Level** - User learns that the Laboratory has eight core competencies and a basic mission to reduce the nuclear danger.

- **Second Level** - User can explore the entire site at the second level while still seeing all the different examples available to him.

- **Third Level** - User can browse information pertaining to a specific example he has chosen.

- **Fourth Level** - If the information is compelling to him, the user can click down to this last level to see a detailed picture, movie, or text description of a technology.

The interface also tries to encourage exploration of the environment by not showing everything at once and not flooding the user with a myriad of conflicting choices. While some may argue that not disclosing everything up front tends to annoy users, I like to subscribe to the "less is more approach" when it comes to interface design. Even if a user does nothing but look through the first screen, at the very least he will come away knowing the core competencies of the Laboratory and its central mission.

The Sectors

There are eight sectors that represent the Laboratory's core competencies. These sectors are wedge-shaped and arranged in a circular fashion as seen in Figure 1. The sectors represent these core competencies.

- **Sector 1** - Nuclear Science Plasmas and Beams (red)
- **Sector 2** - Nuclear and Advanced Materials (orange)
- **Sector 3** - Nuclear Weapons Science and Technology (yellow)
- **Sector 4** - Analysis and Assessment (green)
- **Sector 5** - Complex Experimentation and Measurements (blue)
- **Sector 6** - Theory, Modeling, and High-Performance Computing (magenta)
- **Sector 7** - Bioscience and Biotechnology (purple)
- **Sector 8** - Earth and Environmental Sciences (brown)
To help the user identify and navigate through these sectors, the sectors are differentiated by both color and shape. The colors have been chosen to try and suggest the nature and characteristics of the different core competencies.

The sector shapes are intended to be arbitrary and reflect the characteristics of the star atlases after which they are modeled. Originally, the shape of a sector was intended to have meaning for the user. The length and width of a sector were supposed to imply the depth and breadth of a particular core competency. This approach was eventually dropped because it was felt that arguments would flare over how the sector’s shape equates to the importance of a core competency.

In addition to the sector map, there is an information window in the screen’s lower right hand corner (refer to Figure 1). This window provides a place for help messages and pop-ups describing the different technology sectors. The information window also keeps screen clutter to a minimum allowing the user to explore the environment more easily.

When the program is first started, an animation plays “transporting” the user into the universe and displaying a map showing all the sectors. When a user selects a particular sector, an animation plays; first, drawing the user into the chosen sector then finishing by displaying the sector by itself. All the sectors are displayed with the narrow, pointed part of the sector starting in the lower left-hand corner of the screen and opening up towards the right. While

Figure 1 - The first level of the program is the main screen which shows a map of the technology sectors.
it would be nice to display each sector in its original orientation as shown in the map, a uniform display was chosen for familiarity and because it maximizes the available on-screen real-estate.

Each sector is framed by a color-coded bar that is used throughout all screens and examples in a particular sector. This helps cue the user to that she is in a particular sector, even though she may be buried four levels deep.

**The Stars**
Within the sectors are stars representing an example of a particular core competency. As illustrated in Figure 2, the stars are further differentiated by a color which relates to the specific mission area the example represents:

- Red stars - examples that relate to defense mission activities
- Yellow stars - examples that relate to industrial mission activities
- White Stars - examples that relate to civilian mission activities

![Figure 2 - Second level of program showing Sector 1 with stars representing technology examples and other navigation features.](image)

The use of color, accords with the fact that stars do have different colors. Other characteristics of stars such as magnitude (size) or the binary nature of some stars have been left out of this initial version.
The Planets
Around each star system is a series of four planets as seen in Figure 3. Each planet is explicitly labeled and represents a media element offering more information about a particular example.

- Picture - a picture or diagram with a caption relating to a technology example
- Text - a more detailed text description of a technology
- Movie - animation or video with a caption relating to a technology example
- Contact - The principal investigator or point of contact for more information

Figure 3 - Third level of program showing the solar system with the planets and information window.

To provide consistency for the user, the same four planets with the same colors/textures are used throughout the project. This works out well since information about which sector an example belongs to is already coded by the colored frame. If more information is needed, another planet (or even a moon circling a planet) can always be added. However, these basic four seem to work out best for most situations.

Other planetary characteristics such as size or geographical features are not used in this version. The different sizes of the planets are due to the perspective the solar system is viewed from. Size could be used to signify relative importance of different media types, but I wanted to emphasize the technology example, not the media types. Also, while it would be neat to show geographical detail on the planets, that level of detail would be unnecessary right now and would be confusing to the user.
In addition to the planets, an information window is also provided in the lower left-hand corner of the screen. As the user moves his mouse over a planet, a brief sentence or picture is displayed in the information window. In this way the user can see the thumbnail picture or read a brief description and decide whether it is worth going down another level. The information window also provides a means of displaying help messages letting the user know that a particular example is missing a media element. The information window is also where the principal investigator’s contact information is displayed.

Eventually the “Contact” planet could be linked to a resume page and picture providing information about the researcher as well as the division and group to which he or she belongs. This is the ideal place to link back into the structure of the Laboratory and provide relationships between the core competencies and the technical groups that work in that area. For this version of the project however, that information was unavailable to me.

“Let there be Light” - Building the Universe

Choosing a Distribution Platform
While there was a wide range of tools and platforms to choose from, I decided to create a project that would run on the Macintosh platform. While this decision may seem to limit potential distribution, there were a couple of compelling reasons to go with the Macintosh.

The first reason has to do with government computer buying practices. A typical government-bound PC does not come equipped like a computer that can be bought at a local computer store. While a computer store outfits a machine with the latest in multimedia technology, most government machines don’t even come with CD-ROM drives. Don’t even think about asking for a sound card either. This practice is carried over into some companies as well.

I believe this inane practice persists because there is a belief that multimedia technology outrageously increases a computer’s cost, which is of course false. There may also be a fear that employees will spend time playing games instead of working. Given the lack of suitable output, creating a Windows CD-ROM that uses multimedia to communicate information would be a lost cause.

Since most Macintoshes come with CD-ROM drives and sound as part of the standard configuration, there is not much that can be done to extract these goodies from the computer (though I’m sure an effort has been made by government procurement). Hence, there is a strong likelihood that someone with a Mac can take advantage of the multimedia capabilities
of the system. However, the practice of ordering dull Windows computers seems to be changing, and creating a Windows version of this CD-ROM wouldn't require much additional work.

Deciding on a Format
Once the platform was chosen, some basic decisions had to be made about the screen layout and color depth used for the project. Many multimedia programs allow you to design a project for a particular screen size. For this project I decided to use a standard screen size of 640 x 480 pixels.

I standardized on this size screen because a number of Macintosh computers have been sold with 13 and 14 inch monitors. Only recently have 16 and 17 inch monitors (with screen sizes of 1024 x 768 pixels) become the computing standard. Even though I went with a smaller screen size, this does not prevent the project from running on larger monitors. The smaller screen size also facilitates running the program on a laptop computer.

Authoring Environment
Once the delivery platform was decided upon, the next step was to get the tools to develop the product. The project was eventually authored in Apple Media Tool on a Power Mac 8100/80 (see Figure 4). The original choices ranged from a Windows machine running Asymetrix Toolbook or Visual Basic to a Mac running Macromedia Director or Hyper Card. Apple Media Tool was the program of choice because it offered a lot of flexibility and ease in creating and updating the environment.

Figure 4 - The Apple Media Tool Environment

Apple Media Tool works on an object-based metaphor. A framework of screens is created and then filled with objects. The objects are placed in screens and then told how to react based on user input. The objects can be either pictures, sounds, or movies. Links are made between
screens by simply drawing a line from one screen to another. If object or screen names are changed during the project, they are automatically changed in the objects that reference them. Since Apple Media Tool only references a file, it is easy to make changes to the basic media components and have those changes appear immediately in Apple Media Tool.

If more capability is required, Apple Media Tool also has a programming environment that allows the developer to tweak the compiled code for better performance. The final advantage is that Apple Media Tool generates both Mac and Windows executables so it is possible to author once and distribute for both platforms.

**Creating the Content-Screens, Icons, and Pictures**

I created pictures for the screens using Adobe Illustrator and Adobe Photoshop. The initial screens were drawn and laid out in Illustrator. The Illustrator file was then opened in Photoshop, where it is rasterized, converted from the CMYK color space to RGB, and tweaked for placement into Apple Media Tool. While this approach may seem drawn out, it takes advantages of the different programs in creating a screen.

During the initial design phase, changes and alterations can be made easily and quickly in Illustrator. As the design is finalized, the Illustrator file is pulled into Photoshop and separated into layers. The layers in Photoshop let new elements from Illustrator to be introduced without messing up the rest of the picture. This approach also allows picture elements to be reused across a number of different files. For example, using layers allowed me to easily copy the navigation buttons for the sector screen from one file to another. For the final, final image the file is flattened and saved out as a PICT file. The icons used throughout the project were created in the same fashion.

Pictures intended to support the technology examples were either scanned, downloaded off the World Wide Web, or captured off of videotape. These pictures were then touched up using Photoshop or DeBabelizer. In fact, DeBabelizer often did a better job of reducing the photos, altering palettes, or de-interlacing photos than Photoshop.

A decision was made early in the project’s development to design the graphics for optimum display on a screen set to use 16-bit color instead of the usual 8-bit color. This means I had thousands of colors to choose from instead of only 256 colors. The greater bit depth eliminates the need to create a common palette of colors to use in the project and made image manipulation much easier.

While this decision may again limit distribution, most Macs can already display thousands of colors. Those Macs that don’t support 16-bit color are usually older computers that wouldn’t be good multimedia machines anyway. Even though the project works best under thousands of colors, it is still possible to run it under 256 colors.
Creating the Content-Sounds
Trying to find appropriate sounds for the “universe” turned out to be one of the most challenging aspects of this project. While there are a lot of different clipart collections, photo archives, and fonts on the market, there are few sound clip collections. Most sound effects collections on the market consist of everyday sounds like car horns, birds chirping, running water, etc. Because of the generic nature of these CDs, it is hard to find the right sounds to fit the character of the product. Also, there are a lot of sounds to muddle through.

The ideal approach would be to have someone create custom sounds and music for the project. Since there was no money in the budget for an orchestra, the next option left was to “borrow” the sounds. Right now, some of the sounds used have been modified from Microsoft’s Windows95 operating system. The “Robotz” sound scheme offered the high-tech character that was intended for this product and has made excellent addition to the universe. While attempts were made to license the sounds, Microsoft avoided making a specific deal and stated “fair use” practices. This fuzzy statement has been interpreted to mean that it is possible to use the sounds for this prototype, but if the CD ever goes into wide distribution these sounds will have to be changed.

Creating the Content-Movies
The videos for the project were created in one of two ways. The first method was to capture the clip directly off videotape using a Radius Studio capture system. The videotape was a compilation of different examples provided by Los Alamos Public Affairs office. The challenge was to try and find examples and use as many of these little snippits of video as I could as supporting media. The other way was to make a movie out of still images. For example, in one instance, still frames from a computer simulation were compiled in Adobe Premier and then saved as a QuickTime movie. While this is not the most elegant solution, it works.

Creating the Content-Text Examples
Apple Media Tool can accept text in rich text format so it is possible to specify fonts, typeface style, and color and retain those characteristics in the project. Due to the propriety nature of much of the Laboratory’s information, and due to security issues, it was not possible to include the absolute latest and greatest examples of Laboratory technologies. Instead, examples were drawn from publicly available sources such as the Internet and Laboratory publications like Dateline Los Alamos and the Laboratory’s annual Research Highlights.

I drew most heavily on Dateline as a source of information for a couple of reasons. First, this publication provides brief snapshots of current Laboratory technologies and remains pretty current on Laboratory developments. Also, the articles are usually well written, short, and aimed at a general audience—all good characteristics for on-line text. Second, the Laboratory
is promoting the use of on-line libraries, and many issues of Dateline have been converted to
the Adobe Acrobat format. It was a simple matter to download the Acrobat files, copy out
the information into Microsoft Word, convert the Word file into a rich-text format (rtf) file,
and place the file into Apple Media Tool.

The Long Burn - Creating the CD-ROM
When the project was complete, it was transferred to recordable CDs. While recordable CDs
are not as reliable as a regular stamped silver CD, the recordable CD offers good value for
small runs. The problem with recordable CDs is that there is no guarantee that they will be
compatible with a range of different computers.

After a little investigation, I discovered that the problem with getting reliable performance
does not lie with recordable CDs. Apparently, the CD-ROM standard allows manufacturers
to tweak the specifications to meet their own performance goals. Because of this flexibility, a
CD-ROM title may run perfectly in one machine but refuse to work in another—even
though they may be similar models.

Another factor to consider when creating a CD-ROM is where files are placed on the disc.
CD-ROMs were intended for sequential access of audio information rather than random
access of data files. Also, a CD-ROM spins at different speeds depending on where the read
laser is positioned—so file placement on the CD directly affects a title’s performance.

Files that are accessed frequently, title screens and movies for example, should be placed
closer toward the center of the disk. Content should be placed in the middle of the disk.
Installation programs and infrequently used information should go on the outer edges. While
file placement isn’t the only factor that can affect how well a title performs, it can make a big
difference.

Conclusion

My biggest concern for this project has been the clarity of the metaphor and ease of
navigation. I questioned a number of users as to whether or not using the metaphor made
sense, and asked their opinion as to what improvements could be made to the interface. The
general response has been very favorable and most people seem to enjoy using the product
and learning about the different Laboratory technologies.

I also made an effort to see if there were similar projects using CD-ROMs to communicate
technical government information. I managed to find a couple, but neither one used a
metaphor to communicate information. The first was a project by Hanford called Hanford
Highlights. During the Manhattan project, Hanford was the site where Plutonium for the
first nuclear bomb was manufactured. This project is intended to inform people about the environmental clean-up technologies being developed at Hanford. It was a Windows CD-ROM that was updated about every 4-5 months. The project eventually collapsed due to budgetary reasons.

Before its demise, the project had been very well received but the project team had tremendous difficulties delivering the content. As I mentioned before, the government doesn't normally buy multimedia computers and a lot of effort was required by the team so the target audience could see the final results.

The second CD-ROM was from Sandia National Labs. Other than the fact that it has won some kind of award from New Media, I don't know much about it. I tried contacting Sandia to borrow a copy but was told that the CD-ROM is no longer available. Obviously, the creators didn't count on user demand.

The LANL Universe offers some unique possibilities to communicating scientific and technical information to the public. The acceptance of products like this can be seen in the rapid growth in consumer CD encyclopedias like Microsoft's Encarta or similar offerings from Compton's and Grolier's. Given the growing popularity of computer-delivered information, this seems to outweigh the time and cost involved in creating a CD-ROM.
Sources Used in this Project


APPENDIX A
APPENDIX B
The Los Alamos Universe
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<tr>
<th>FILE</th>
<th>SECTOR</th>
<th>MISSION</th>
<th>DESCRIPTION</th>
<th>CONTACT</th>
<th>AUX FILES</th>
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</table>
| S1EX1 | Sector 1| Industrial | Optical anti-lock brakes                   | Lynn Veeser  
Hydrodynamic & X-ray Physics  
505.667-7741  
lveeser@lanl.gov              | S1EX1TTL.RTF  
S1EX1.RTF  
S1EX1POP.RTF  
S1EX1CNT.RTF  
S1EX1PIC.PIC/CAP |
|       |        |         |                                             |                                                                         |                             |
| S1EX2 | Sector 1| Civilian | Magnetic Grippers                          | Chuck Rzeszutko  
Licensing  
505.665-3613  
crzeszutko@lanl.gov     | S1EX2TTL.RTF  
S1EX2.RTF  
S1EX2POP.RTF  
S1EX2CNT.RTF  
S1EX2PIC.PIC/CAP  
S1EX2VID.MOV/VCP |
|       |        |         |                                             |                                                                         |                             |
| S1EX3 | Sector 1| Civilian | Compton X-ray source                       | Dinh Nguyen  
High-Power Microwaves, Advanced  
Accelerators, and Electrodynamics  
505.667-9385  
dcnguyen@lanl.gov       | S1EX3TTL.RTF  
S1EX3.RTF  
S1EX3POP.RTF  
S1EX3CNT.RTF  
S1EX3PIC.PIC/CAP  
S1EX3VID.MOV/VCP |
|       |        |         |                                             |                                                                         |                             |
| S1EX4 | Sector 1| Industrial | Ion Implantation                          | C. Munson  
Applied Plasma Technologies  
505.667-7509  
cmunson@lanl.gov   | S1EX4TTL.RTF  
S1EX4.RTF  
S1EX4POP.RTF  
S1EX4CNT.RTF  
S1EX4PIC.PIC/CAP  
S1EX4VID.MOV/VCP |
|       |        |         |                                             |                                                                         |                             |
| S2EX1 | Sector 2| Industrial | 777 engine modeling                       | Mike Stout  
Materials Research & Processing Science  
505.667-6750  
mstout@lanl.gov  | S2EX1TTL.RTF  
S2EX1.RTF  
S2EX1POP.RTF  
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| S2EX2 | Sector 2 | Industrial  | Microwave resonators              | D. Wayne Cooke  
*Ceramic Science and Technology*  
505.667-4274  
cooke@lanl.gov | S2EX2TTL.RTF  
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S2EX2POP.RTF  
S2EX2CNT.RTF  
S2EX2PIC.PIC/CAP |
|       |        |             |                                   | Dale Tuggle  
*Tritium Science Engineering*  
505.667-4606  
dtuggle@lanl.gov | S2EX3TTL.RTF  
S2EX3.RTF  
S2EX3POP.RTF  
S2EX3CNT.RTF  
S2EX3PIC.PIC/CAP |
| S2EX3 | Sector 2 | Defense     | Hydrogen Automobiles              | Fernando Garzon  
*Electronic & Electomechanical Materials and Devices*  
505.667-6643  
garzon@lanl.gov | S2EX4TTL.RTF  
S2EX4.RTF  
S2EX4POP.RTF  
S2EX4CNT.RTF  
S2EX4PIC.PIC/CAP |
|       |        |             | Oxygen Sensors                    | Jeff Bloch  
*Astrophysics and Radiation Measurement*  
505.655.2568  
jbloch@lanl.gov | S3EX1TTL.RTF  
S3EX1.RTF  
S3EX1POP.RTF  
S3EX1CNT.RTF  
S3EX1PIC.PIC/CAP |
| S3EX2 | Sector 3 | Industrial  | Advanced Reservoir Management     | Joseph M. Kindel  
*Industrial Partnership*  
505.667-3718  
jkindel@lanl.gov | S3EX2TTL.RTF  
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| S3EX3 | Sector 3 | Defense   | Acoustic Resonance Spectroscopy | Paul Lewis  
*Measurement Technology*  
505.665-0932  
lewis@lanl.gov | S3EX3TTL.RTF  
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| S3EX4 | Sector 1 | Civilian   | Russian Fusion                | Irvin Lindemuth  
*Plasma Physics Applications*  
505.667-7844  
irl@lanl.gov  | S3EX4TTL.RTF  
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S3EX4CNT.RTF  
S3EX4PIC.PIC/CAP  
S3EX4VID.MOV/VCP |
| S4EX1 | Sector 4 | Civilian   | TRANSIMS                      | Chris Barrett  
*Technology and Safety Assessment*  
505.665-3405  
barrett@lanl.gov | S4EX1TTL.RTF  
S4EX1.RTF  
S4EX1POP.RTF  
S4EX1CNT.RTF |
| S4EX2 | Sector 2 | Defense   | Yucca Mountain                | Julie A. Canepa  
*Nuclear Waste Management R& D*  
505.667-4109  
canepa_julie@lanl.gov | S4EX2TTL.RTF  
S4EX2.RTF  
S4EX2POP.RTF  
S4EX2CNT.RTF  
S4EX2PIC.PIC/CAP |
| S5EX1 | Sector 5 | Industrial | Laser Detonation              | Dennis Paisley  
*Detonation Science and Technology*  
505.667-7837  
dxp@lanl.gov | S5EX1TTL.RTF  
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| S5EX2 | Sector 5 | Civilian | LIDAR | David Holtkamp  
*Hydrodynamic and X-ray Physics*  
505.667-8082  
dholtkamp@lanl.gov |
| Date line | 07/93 |
| S5EX3 | Sector 5 | Industrial | PIXY | David Fradkin  
*Hydrodynamic Applications*  
505.667-7456  
davidf@lanl.gov |
| Date line | 12/93 |
| S6EX1 | Sector 6 | Industrial | Circuit design codes | Michael E. Jones  
*Plasma Physics Application Group*  
505.667-7760  
mej@lanl.gov |
| Date line | 02/94 |
| S6EX2 | Sector 6 | Civilian | Turbulence Simulation | Shi-Yi Chen  
*Complex Systems*  
505.667-5416  
syc@lanl.gov |
| Date line | 06/94 |
| S6EX3 | Sector 6 | Industrial | KIVA Computer Code | Anthony A. Amsden  
*Fluid Dynamics*  
505.667-9095  
aaa@lanl.gov |
<p>| Date line | 03/94 |</p>
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<td>Sarah Hayes  Partnership Development 505.665-5375  <a href="mailto:smh@lanl.gov">smh@lanl.gov</a></td>
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<td>John Coogan  Waste Treatment and Minimization Science and Technology 505.665-0186  <a href="mailto:jcoogan@lanl.gov">jcoogan@lanl.gov</a></td>
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| S8EX3| Sector 8 | Industrial | Acoustic mini-fridge | Gloria Bennett  
Nuclear Technology and Engineering Division  
505.665-0752  
gbennett@lanl.gov | S8EX3TTL.RTF  
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| S8EX4| Sector 8 | Civilian | Heat-stress monitor | Larry Berkbiger  
Measurement Technology  
505.667-2231  
lwb@lanl.gov | S8EX4TTL.RTF  
S8EX4.RTF  
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