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U.S. DEPARTMENT OF
ENERGY

RADAR 2

Radiological Database & Reporting Application

Application for 2011 University of California

Larry L. Sautter Award for Innovation in Information Technology



INFORMATION TECHNOLOGIES AND SERVICES DIVISION

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1. Project Title

RADAR -- Radiological Database and Reporting Application v2.0

1.1 Project Participants

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Project Team:

Title	LBNL Employee
Functional Owner	David Kestell, Radiological Control Manager, Radiation Protection Group, Environment, Health & Safety Division
Project Manager	Vanessa Arce Kaskiri, IT Business Systems Department
Developers	Jeremy Pease, IT Business Systems Department
	Michael Kremer, IT Business Systems Department
Safety Software Quality Assurance Oversight	Lana Newman, IT Business Systems Department
Student Assistants	Bryan Gnipp, upper-division undergraduate UCB
	Sierra Larson, upper-division undergraduate UCB
	Alix Leighton, upper-division undergraduate UCB
	Justin Leung, upper-division undergraduate CSU

2. Project Summary

The Radiological Authorization Database and Reporting (RADAR) 2.0 System was developed and deployed at Lawrence Berkeley National Laboratory (LBNL). RADAR 2.0 is used to authorize, receive, inventory and report on radiological material at LBNL. The application is used by the Radiation Protection Group (RPG) of the Environment, Health & Safety Division and Principal Investigators across multiple Divisions at LBNL.

Key innovations for this project include: processing of complex radiological subject matter calculations in real time within the application, increased user base via self-service PI Inventory module, and project-specific quality assurance resource allocation.

The project is a success because it has improved RPG process efficiency, improved LBNL scientist research capabilities and visibility, and ensures, in a very high quality manner, public safety and compliance with the University of California and Department of Energy (DOE) regulations regarding the safe handling, storage and use of radiological material.

3. Goals & Achievements

3.1 Goals

High Caliber & Web-Based: The vision for RADAR 2.0 was to move to a dynamic, stable and web-based Radiation Protection Group system. As a system that may affect human safety, the Safety Software Quality Assurance (SSQA) requirements for this project were extensive.

Responsive & Nimble: The Radiation Protection Group must anticipate compliance changes and respond quickly. RADAR 2.0 was built with this in mind. It utilizes a nimble business rules and workflow methodology.

Accountable & Transparent: For the first time, individual Principal Investigators can autonomously manage their radiological inventory. The “PI Inventory” module of the application offers a best-in-class model for management of physical materials with timely updates so that lab-wide aggregate thresholds can be determined with precision at any given moment.

Improve Business Processes: David Kestell, Radiological Control Manager and the functional owner for the project, sought to clarify and revise cumbersome process flows wherever possible. A predominantly paper process has been automated with an intuitive Dashboard notification system, tedious paper routing has been eliminated, and the Radiation Protection Group has achieved a record level of efficiency and on-time reporting.

Sophisticated & Compliant Reports: The RADAR 2.0 application has over 40 complex reports that are generated in real-time with extensive selection criteria. Compliance with DOE and UC regulations are ensured via weekly, monthly, quarterly and annual reports.

3.2 Achievements

RADAR 2.0 achievements include:

- Highly-rated (per Peer Review) Radiological Material Management application
- Improved business efficiency for RPG Group
- Increased user base, usability and user satisfaction
- Full DOE and UC regulatory compliance
- Quality application that incorporates stringent calculation and quality assurance tests
- Implementation of Safety Software Quality Assurance (SSQA) protocols

RADAR 2.0 utilizes a user-friendly dashboard interface and provides the following radiation management-specific elements:

- Exceptional and real-time hazard class, nuclear fraction and decay calculations
- Nimble user workflow with trace management directly to compliance requirements
- Functionally-owned role-based web-access controls
- User access by Principal Investigators to manage their respective inventory

The RADAR 2.0 technical team also utilized innovative solutions to a complex, time-sensitive, and labor-intensive project:

- Collaborative project management using a state-of-the-art SaaS Project Management Software (Daptiv)
- Leveraging UC and Cal State Student Assistants to learn the application, write test cases, and perform much rigorous Safety Software Quality Assurance testing
- Dedicated IT Project Manager as intermediary between customer and developer

4. Project Description

4.1 Background

LBNL is a member of the national laboratory system supported by the U.S. Department of Energy through its Office of Science. LBNL conducts unclassified research across a wide range of scientific disciplines, some of which require radiological materials. Lab scientists must first obtain permits from the Radiation Protection Group (RPG), who assure that radiological material is used in a safe and regulated manner. All radiological material must be managed and closely monitored through its entire lifecycle, from acquisition through disposal. Every step is carefully controlled for public safety adherence to governing regulations.

The RADAR 2.0 application delivers a high quality user experience that is superior to RADAR 1.0., which was a legacy thick client application initially developed over 15 years ago. RADAR 2.0 eliminated manual and paper processing that RADAR 1.0 required. The disparate configuration of IT applications and paperwork in RADAR 1.0 was the driving force behind the initiative to develop RADAR 2.0. Users can access use requirements for radiological material, receive radiological material for use in scientific laboratories, inventory all in-use material, record inventory survey information, and generate reports specific to RPG, UC and DOE. Given the specific domain complexity, IT staff had to develop

a high degree of process understanding and subject matter expertise to design, build and deploy the application.

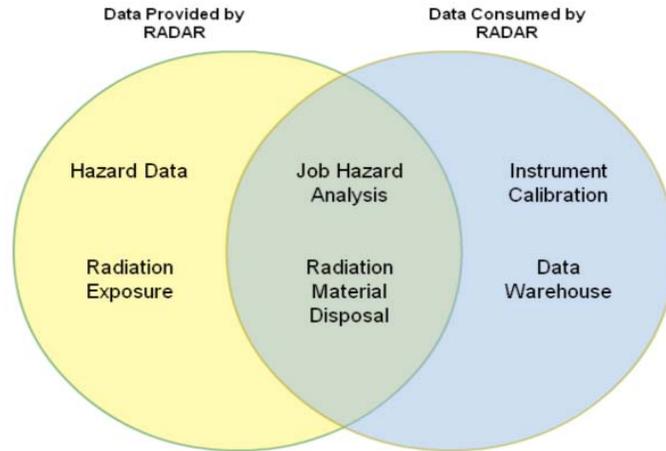
4.2 Technology

RADAR 2.0 is based on a typical web application technology stack, including database, application and web servers, and reporting technologies. The application design follows Model-View-Controller (MVC) architecture. The development team used some commercial and some LBNL-developed libraries to support development. The following table lists the technologies utilized in the project:

	Technology	Notes
Database	Oracle 10g	
App/Web server	Microsoft IIS 6.0	
Programming Languages	ASP.NET in C#, HTML, Javascript, PL/SQL, ASP.NET AJAX Control Toolkit, Telerik Web Controls	Includes LBNL custom .DLL class libraries written for ASP.NET (C#)
Reporting	Actuate 9.0	Unique reports with customizable parameters
Development Tools	Microsoft Visual Studio 2008, Oracle JDeveloper 11g, Oracle SQL Developer 2.1.1, Quest SQL Navigator 6.1	Used the correct development tool for the project tasks
Repository	Microsoft Visual Source-Safe 8.0	Repository for the Code base, Database creation scripts, and all of the supporting release documentation
Testing	HP Quicktest, Oracle SQL Developer Unit Test	Automated unit tests of application and safety-related database calculations
Auditing	PL/SQL stored procedures and triggers within the Oracle Database	Database driven, application independent

Data is provided to and from RADAR 2.0 to support other radiological material work, hazard analysis, and programs that support the Radiation Protection Group's mission.

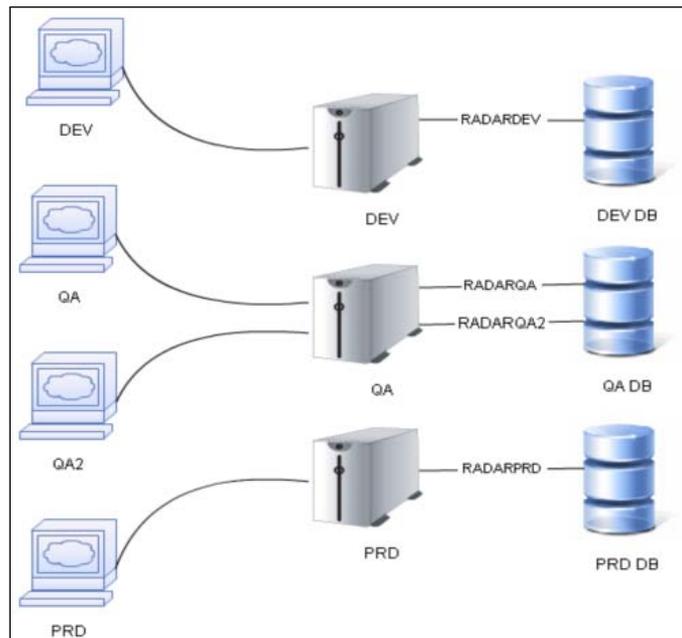
Below is a visual representation of how other systems at LBNL interface with RADAR 2.0:



RADAR 2.0 Data Interfaces

4.3 Infrastructure

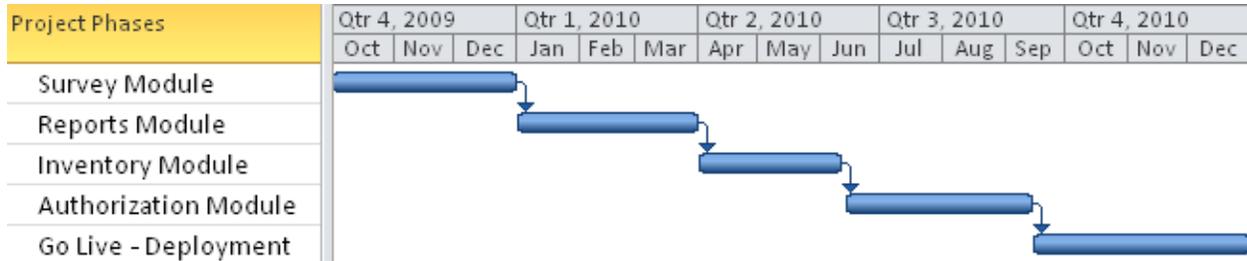
RADAR 2.0 was deployed on LBNL’s existing web infrastructure. The infrastructure is maintained by a separate IT team, allowing the development team to focus exclusively on the customer requirements and application design. RADAR 2.0 has requirements for a very strict code promotion and release process, and one of the innovative ideas implemented during the project was the utilization of a second mirrored QA environment - QA2 - that allows the development team to perform quality assurance testing in a separate QA environment than the application users.



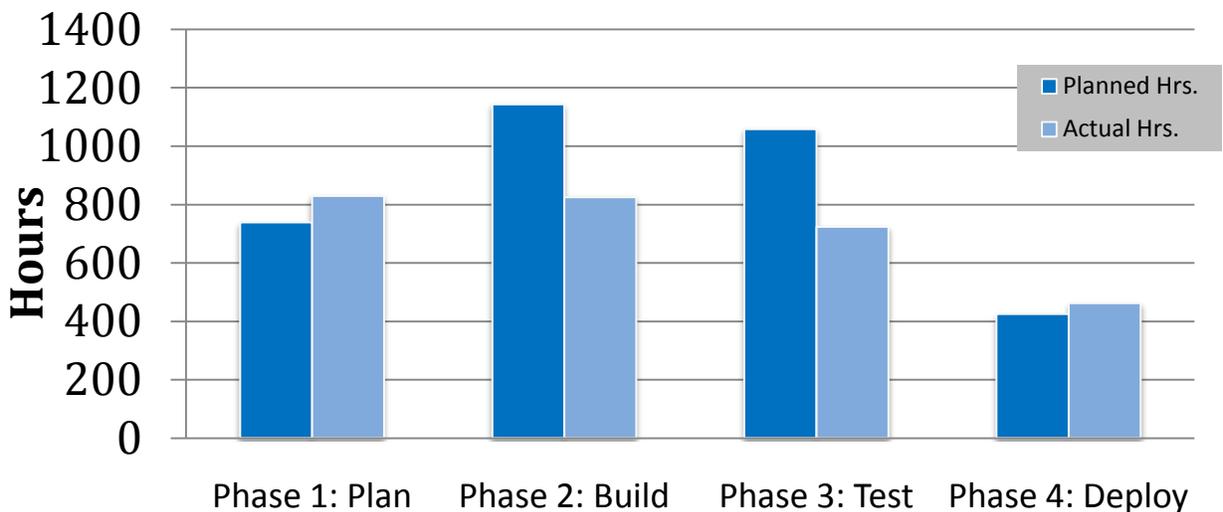
RADAR 2.0 System Configuration Diagram

4.4 Schedule and effort

The RADAR 2.0 Project Team timeline ran 15 months, from October 1, 2009 to December 31, 2010.



Project Planned Hours vs. Actual Hours



4.5 Project Management Tools & Processes

Using both Project Management Institute (PMI) and Software Development Life Cycle (SDLC) methodologies, the Project Manager developed a systematic approach to completing tasks and meeting milestones. Beginning in October 2009, a closely monitored schedule was developed, with task and work breakdown structures. The development team would meet 2-3 times a week to review, demo and discuss. Student Assistants participated in weekly team meetings and in 1-on-1 meetings with the Project Manager to coordinate and check in. Weekly stakeholder meetings with follow-up meeting minutes kept the functional owner in the loop on status as well as clarifications on scope and requirements. All project management tracking was done via Daptiv Project Management Software.

5. RADAR 2.0 Sample Screenshots

Dashboard

Authorization Renewal Due

Auth No	Auth Type	Haz Class	Renewal Due Date
212	SSA	I	5/31/2011
1161	RWA_U	II	6/7/2011

Open Inventory Transactions

Trans. ID	Type	Status	Requested By	Requested Date	Cont. ID	Auth No.	Days Since Created	Last Modified By
20964	Received	Needs Approval	Reeves,Naomi E	01/31/2011	030197	1020	106	Naomi E Reeves
22001	Received	Needs Approval	Maxwell,Craig	05/02/2011	030384	1092	15	Craig Maxwell
22192	Transferred to Authorization/Location	Needs Completion	Kestell,David J	05/17/2011	020624	140	0	David J Kestell
22193	Transferred to Authorization/Location	Needs Completion	Kestell,David J	05/17/2011	030261	415	0	David J Kestell

Authorization Screen

Radiological Work Authorization #1009 , Class II , Type: Renewal , Eff. Date: 04/22/2011

Authorization Status: Status Date:

Auth No: 1009 Auth Status: Active Status Date: 08/24/2009
 Class: II Last Modified Date: 04/22/2011 Created Date: 09/22/2010
 Container Count: 77 SS Container Count: 89 Due Date: 10/22/2012

Title: Radiation Protection Group (RPG) Technical Services (TS) Analytical Lab Operation
 *Division: Environment, Health & Safety
 Division Director: Fleming,Douglas M

Survey
 Frequency: Monthly
 Override:
 Reason:
 Approval:

History

Authorization Status	Status Date
Active	8/31/1998

Container Receipt by Authorization Report



Container Receipt By Authorization Report

03/01/2011 to 05/27/2011

Nuclide	Trans #	Container		Receipt Date	Receipt Activity (Ci)	Current Activity (Ci)
		ID	Status			
Auth #: 1009		PI: David Rodgers				
Am-241	21511	030322	Active	03/31/2011	1.08E-10	1.08E-10
Am-241	21512	030323	Active	03/31/2011	1.08E-10	1.08E-10
Am-241	21513	030324	Active	03/31/2011	2.43E-09	2.43E-09
Am-241	21514	030325	Active	03/31/2011	4.05E-10	4.05E-10
Am-241	21515	030326	Active	03/31/2011	1.08E-10	1.08E-10
Am-241	21516	030327	Active	03/31/2011	1.08E-10	1.08E-10
I-125	21564	030335	Active	04/05/2011	4.30E-07	2.62E-07
I-125	21750	030348	Active	04/12/2011	1.00E-06	6.60E-07
I-131	21565	030336	Active	04/05/2011	5.80E-07	1.42E-08
I-131	21751	030349	Active	04/12/2011	5.00E-07	2.24E-08
Th-230	21517	030328	Active	03/31/2011	1.35E-10	1.35E-10
Totals:					2.51E-06	9.62E-07

Search Screen



Radiological Authorization And Reporting System

Home Authorizations Survey Inventory Reporting System Configuration

Search

Search Type:

- Authorizations
- Locations
- Inventory
- Surveys
- Personnel

Select either the specific Location or the Building/Room

Location: 055-0139

Building No.: Select Building

Room No.: Select Room

Search Cancel/Exit

Results

Location	Type	Auth No.	Start Date	End Date	Biosafety Cabinet	Fume Hood	Glove Box	Containers
055-0139	RSA	10-03	05/05/2010		No	No	No	0
055-0139	RA	1010	07/10/1996		No	No	No	0
055-0139	RSA	1010	07/10/1996		No	No	No	0
055-0139	RA	1011	12/16/1996	08/06/2003	No	No	No	0
055-0139	RMA	1011	12/16/1996	08/06/2003	No	No	No	0
055-0139	RA	1012	07/02/1998	01/18/2005	No	No	No	0
055-0139	RA	1013	04/21/1998		No	No	No	17
055-0139	RSA	1013	04/21/1998		No	No	No	17
055-0139	RA	1041	12/16/1996		No	No	No	38
055-0139	RMA	1041	12/16/1996		No	No	No	38
055-0139	RSA	1041	12/16/1996		No	No	No	38
055-0139	RA	1042	01/15/1998	01/06/2005	No	No	No	0
055-0139	RSA	172	10/15/1999		No	No	No	28

6. Significance

6.1 Improved Business Efficiency

Upon release of RADAR 2.0, the RPG group quickly realized dramatic gains in efficiency and customer satisfaction. The table below provides efficiency comparisons between RADAR 1 and RADAR 2.0:

Process	RADAR 1	RADAR 2.0
Average time to complete new authorization	30 days	3-5 days
Average time to complete updated authorization	10 days	1-2 days
Number of PI-submitted quarterly inventory updates	0	65
Average time to complete quarterly inventory	30 days	6 days
Average time to review survey	30 days	9 days
Average time to complete inventory transaction	5 days	1 day
Average time for non-inventory update transactions	n/a	2 days
Total number of inventory transactions since deployment	n/a	2138
Total number of surveys (initiated, in-progress, complete) since deployment	n/a	1733

6.2 Improved Research Capabilities

RADAR 2.0 enables the LBNL scientific community for the first time to directly manage their inventory and associated permitting processes without inefficient, opaque and error-prone manual intermediation. RADAR 2.0 provides an intuitive and user-friendly interface for scientists that is powerful and unrivaled in the Radiation Material Management application space. PIs and researchers also responded positively to the RADAR 2.0 Dashboard, citing ease-of-use and a good layout of their particular information needs.

6.3 Improved Accountability & Safety

As evidenced by the RPG Peer Review in November 2010, RADAR 2.0 outperforms RADAR 1 by tenfold. RADAR 2.0 also automates a previously paper and error-prone process. RADAR 2.0 represents significant subject matter expertise and technological ability.

- Lab-wide nuclear thresholds determined precisely at any given moment

- All logins, record edits and updates tracked to the second
- Complex, thoroughly tested, real-time calculations for the following:
 - Non-Sealed Container Hazard Class Calculation
 - Nuclear Fraction Calculation
 - Sealed Source Hazard Class Calculation
 - Isotope Decay Calculation
- Regulatory compliance traced through all user workflows
- High marks received by peer review for application quality and sophistication
- Comprehensive Reports Module supports workflow and compliance requirements

7. Success: Criteria And Benefits

Category	Criteria	Benefits
Innovation	<ul style="list-style-type: none"> ▪ Radiological Subject Matter: calculations and functionality ▪ Established successful Student Assistant Program for Quality Assurance ▪ Utilized Daptiv® Project Management Software 	<ul style="list-style-type: none"> ▪ Complex compliance requirements addressed ▪ Model SSQA Project (comprehensive, reliable, repeatable) ▪ Useful 3rd party project management tool
Safety	<ul style="list-style-type: none"> ▪ UC & DOE compliant ▪ RADAR 1 documented deficiencies and corrective action items satisfied 	<ul style="list-style-type: none"> ▪ Increased human safety accountability ▪ Best-in-class radiological material control at National Laboratories
Efficiency & Usability	<ul style="list-style-type: none"> ▪ Significantly expanded user base ▪ Simplified workflow ▪ Reduced email & paper ▪ Centralized & actionable user Dashboard 	<ul style="list-style-type: none"> ▪ Streamlined web-based application ▪ Highly efficient workflow ▪ User-friendly design
Shareable	<ul style="list-style-type: none"> ▪ Conceptually repeatable 	<ul style="list-style-type: none"> ▪ Future collaboration opportunities
Interoperability	<ul style="list-style-type: none"> ▪ Fully utilizes existing LBNL infrastructure 	<ul style="list-style-type: none"> ▪ Reduced cost of hardware, maintenance and training
Collaboration	<ul style="list-style-type: none"> ▪ IT and EH&S divisions worked together on all aspects of the project 	<ul style="list-style-type: none"> ▪ Domain knowledge of RPG and LBNL scientific community implemented into application business logic

8. Testimonials

8.1 Principal Investigators Feedback

Feedback below provided verbally during RPG-coordinated PI Inventory Testing

“This new system is a great improvement.”

“What a time saver - no paper required, just login and get busy. “

“We’re at the beginning here, I’m just starting to understand the scope of work that I can get done.”

“The Dashboard is great. I can see progress on all my items at a glance. “

8.2 National Lab Peer Feedback

“RADAR 2.0’s improvement over its predecessor is substantial, and the people involved in the revision are to be commended for their tenacity and dedication to creating a quality product.” - **William Walker, Subject Matter Expert, Nuclear and Radiological Protection Division, Oak Ridge National Laboratory**

8.3 RPG (customer) Feedback

Feedback below provided electronically by RPG staff

“When Bill Walker from Oak Ridge National Lab visited us in November 2010 as a Subject Matter Expert for our Peer Review of RADAR 2.0 resulting in the FY2011 Q1,Q2 Radiation Protection Group Technical Assurance Report, he indicated that no National Security Agency has been able to do what RADAR 2.0 does. On multiple occasions during our week of RADAR 2.0 review meetings, he complimented EH&S and IT at LBNL; that we were able to build and deploy such a sophisticated, regulations-compliant, accurate and comprehensive Radiological Material Management application. He has never seen anything like it and would gladly use RADAR 2.0 at Oak Ridge. - **David Kestell, Radiological Control Manager, Radiation Protection Group, EH&S Division, Lawrence Berkeley National Laboratory**

“...It also clarified in my mind just how essential Vanessa's leadership of the project has been to the ultimate success of the application. While it was sometimes frustrating to deal with the Project Manager rather than the Developers, Vanessa's calm insistence that both RPG and IT adhere to this model was essential to meeting our deadlines and staying within our scope. You should be proud and pleased with what the team has achieved, particularly Vanessa's leadership.” - **David Kestell, Radiological Control Manager, Radiation Protection Group, Environment, Health & Safety Division, Lawrence Berkeley National Laboratory**

“...our nuclear safety reviewers that were here last week were very complimentary of RADAR 2.0, especially the inventory control mechanisms... The Oak Ridge Subject Matter Expert commented that he was particularly impressed as Oak Ridge had been trying for a number of years to figure out how to do nuclear safety inventory control in an application. The group gave kudos to both RPG and IT for the joint effort in realizing this functionality in the application. Regardless, thank you all for patience and dedication in developing RADAR 2.0.” - **David Kestell, Radiological Control Manager, Radiation Protection Group, Environment, Health & Safety Division, Lawrence Berkeley National Laboratory**

“RADAR 2.0 is a software enhancement that affords the Radiation Protection Group the capacity to keep our inventory of radiological material in real time, which when tracking over 200 potential sites in 40 plus laboratories, and thousands of items, it matters. RADAR 2.0 is an invaluable advance in ensuring our sites’ safety, and is a major step forward in our group’s efficiency. The delivery of our services to our stakeholders depends on RADAR 2.0 and its capacity to track and calculate our material. Its ease of use is a tenfold improvement from its predecessor.” - **Amy Ecclesine, Program Leader, QA and Compliance, Radiation Protection Group, Environment, Health & Safety Division, Lawrence Berkeley National Laboratory**

“RADAR's dashboard and search capabilities afford me better Work Control and Planning (WPC) tools that aid in managing personnel and their daily responsibilities. Having a real-time indicator of tasks and associated compliance due dates allows me to adjust staff priorities and assures a greater degree of compliance with our regulatory requirement. This real time capability creates an efficient way of planning and tracking task completion.” - **Kurt Galloway, Radiological Control Technician Team Lead, Radiation Protection Group, Environment, Health & Safety Division, Lawrence Berkeley National Laboratory**

“RADAR 2.0 has enabled positive improvements across the lab in relation to Radiological Material Management. The application provides clear inventory management to our Principal Investigators; they can electronically initiate container transfers and verify material usage and waste in a timely fashion without members of my staff needing to physically show up at the PI lab to fill-out a paper form. RPG efficiency, accuracy and customer satisfaction have never been higher.” - **David Kestell, Radiological Control Manager, Radiation Protection Group, Environment, Health & Safety Division, Lawrence Berkeley National Laboratory**

9. Lessons Learned & Future Project Suggestions

9.1 Lessons Learned

- Separation between customer and developer is necessary
 - Dedicated Project Manager essential to customer relationship & scope management
-

- Developer-written use case scenarios *before* coding save time and control scope
- Detailed task/issue tracking maintains project integrity
- Realistic effort estimates early on are key to accurate schedule
- Customer sign-off necessary to measure and track requirements vs. final product
- The right student assistants provide tremendous value
- Critical that Functional Owner is available to make decisions
- Iterative process means you update docs for each change
- Test scripts take time and have to be updated regularly
- Students benefit from task prioritization, frequent check-ins and clear leadership

9.2 Future IT Project Suggestions

- Defined Roles
 - Strong Project Manager control of IT/owner relationship
 - Require written test case scenarios before coding
 - Leverage smart and affordable students for documentation and testing
- Clear Expectations
 - Team members have assigned tasks with effort estimates
 - Group demos of completed work done weekly
 - Late requests (scope creep) from customer tracked, not absorbed
 - Everything documented and recorded
- Structured and Frequent Meetings
 - Weekly development verification sessions
 - Weekly team meetings w/ agenda
 - Weekly customer meeting w/ agenda and published meeting minutes

10.

Appendix

10.1 Supporting Documents

All supporting project and safety software quality assurance documents listed below.

	Doc Title	Doc Name	Version	Description
1	Problem Statement	RADAR_II_ProblemStatement.doc	2.0.2	Describes the need in business terms, including the current “as is” state
2	Project Plan	RADAR_II_ProjectPlan.doc	2.0.2	Represents the IT response to the problem statement and includes Project Roles and Responsibilities
3	Requirements Documents	RADAR_II_FunctionalRequirements.doc	2.0.9	Detailed description of all functional program aspects including PI Inventory Reqs. with client signoff

4	Design Documents	RADAR_II_DesignDocument.doc	2.0.3	Describes how the software system will be structured to satisfy the functional requirements including Design Spec for PI Inventory and reports
5	Issue Log	RADAR_II_IssueLog.xls	2.0.21	List of bugs and enhancements
6	Verification and Validation Plan	RADAR_II_VerificationAndValidationPlan.doc	2.0.2	Defines the verification and validation tasks needed to maintain the appropriate software integrity level
7	Change Mgmt Procedure Document	RADAR_II_ChangeManagement.doc	2.0.2	Describes the change management procedures for the application
8	Test Plan	RADAR_II_TestPlan.doc	2.0.3	Outlines application testing, resources needed, and the testing schedule
9	Test Scripts	AuthorizationModule_UAT.doc	2.0.8	Specific scripts for manual user acceptance application testing
		Inventory Module_UAT.doc	2.0.8	Specific scripts for manual user acceptance application testing
		Survey Module_UAT.doc	2.0.8	Specific scripts for manual user acceptance application testing
		Reports Module_UAT.doc	2.0.8	Specific scripts for manual user acceptance application testing
		Roles and Dashboard Module_UAT.doc	2.0.8	Specific scripts for manual user acceptance application testing
		New Container Module_UAT.doc	2.0.0	Specific scripts for manual user acceptance application testing
		RADAR_II_PI_Inventory_UAT.doc	2.0.6	Specific scripts for manual user acceptance application testing
		RADAR II Automated Scripts (HP QuickTest)	n/a	Specific scripts for automated internal IT application testing
11	Test Results	RADAR_II_Unit_Testing	n/a	Developer unit testing results
		RADAR_II_Automated	n/a	Automated testing results
		RADAR_II_UAT	n/a	User acceptance testing results
		RADAR_II_PI_Inventory_UAT	n/a	User acceptance testing results
12	Test Results Reports	RADAR_II_UATTestResultsReport.doc	2.0.1	Describes, in summary format, all UAT feedback.
		RADAR_II_PIInventoryTestResultsReport.doc	2.0.0	Describes, in summary format, all UAT feedback.
		RADAR_II_SafetyFunctionsUnitTesting.doc	2.0.1	Includes: NF Building Calculation, Decay Calculation, Sealed Source Hazard Class Calculation
13	Review Log	RADAR_II_ReviewLog.doc	2.0.14	Log of customer meetings & minutes
		RADAR_II_Source_Code_Review.doc	2.0.1	Log of developer meetings & minutes
14	User Manual	RADAR_II_UserManual.doc	2.0.1	User training manual
15	Go Live Plan	RADAR_II_Go_Live_Plan.doc	2.0.9	Detailed plan for production release