Response to Survey of Utilization of the Fermilab Engineering Manual

G. Apollinari January 23, 2012

Approximately 70 mechanical and electrical engineers work in the Technical Division. Most of them are assigned to 4 R&D Departments: the SRF Development Dep. (~ 30 engineers), the Magnet System Dep. (~16 engineers), the Test & Instrumentation Dep. (~16 engineers) and the Superconducting Materials Dep. (~4 engineers). At this time (January 2012) most engineers are involved in R&D programs with the exception of Mu2e and LBNE (internal projects with CD-0 DOE approval, pursuing CD-1 approval) and some consulting help provided to US-ITER (external project).

In order to perform this assessment, I asked 4 senior engineers with organizational responsibilities (either group leaders, department head or deputy department head) in the 4 R&D departments mentioned above to respond to the questions posed by this survey in consultation or representing the activities taking place in the respective Department.

In the following, I collected their individual answers providing, in each case, a Division Head summary.

Is the Fermilab Engineering Manual being followed and utilized in your organization?			
DH: All engineers report following and utilizing the Fermilab Engineering Manual. This indicates a capillary knowledge of the manual and of its content. It is noted however, that the generic assumption of the Manual on the structure of Projects and Organizations does not conform to reality.			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep**	**Materials Dev. Dep.**
Yes, we are using the Engineering Manual. However, two caveats. First, the manual was only released 18 months ago (July, 2010). So we are still just beginning the use of the manual in many ways. Portions of projects, but not yet entire projects except for some small ones, have followed the manual. Secondly, many engineering tasks and matrix-type project organizations do not fit well into the assumed structure of projects and organizations contained in the Engineering Manual, as explained further below.	Yes.	Yes	Yes, upon the release of the Manual, even though the CPL was underway for more than a year, the manual was followed. The 15 point (A-O) evaluation was done and the scores for chapters 1 thorough 9 totaled. Chapters 1-9 were all considered high risk from the worksheet, the total project score was not considered high risk though. *(The CPL construction included the activities listed in Appendix 1)*

Who is responsible for assigning design tasks to individuals?			
DH: For the Departments that perform design tasks for "external" applications (magnets, cavities, cryomodules, detectors) Project Managers or Project Lead Engineers are identified as the responsible parties that assign design task to individuals. The exception is the Test & Instr. Dep. where all design tasks are "internal" and are needed for the operation of the IB1 testing facility (testing of magnets and cavities). In this department, design tasks are assigned by the organizational structure (Department Head, Deputy Department Head, Group Leaders, etc.). It must be noted, however, that one engineer in the Test & Instr. Dep. is assigned to "external" activities (LBNE LAr Cryostat design) and in this case the default approach (design task assigned by the Project Leader) is followed. It is also interesting to note that in the Materials Dev. Dep., the lead engineer is the Deputy Department Head.			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep**	**Materials Dev. Dep.**
Often, tasks are assigned by the individual's immediate supervisor. But it is also common that someone higher up in the "chain of command", or a project manager who may be in a different department or division, assigns the work. For example, several SRF Department people work full time on the mu2e project and take direction from mu2e project managers who are in the Magnet Systems Department.	Project Lead Engineers.	Design tasks are assigned by the Department Head, Group Leaders, and Project/Lead Engineers.	The lead engineer.

<table>
<tr><td colspan="4">Who performs and how is the determination made of whether a given design effort meets the minimum requirements of the Fermilab Engineering Manual to perform the graded approach risk analysis worksheet?</td></tr>
<tr><td colspan="4">DH:
The responsibility for the determination of whether a given design effort meets the requirement of the Fermilab Engineering Manual follows closely the responsibility for the assignment of design tasks indicated in the previous answer. In particular, for “external” design activities, the responsibility rests with the lead engineer, while for the “internal” design activities typical of the T&I department, the responsibility rests with the Department Head.</td></tr>
<tr><td>SRF Dev. Dep.</td><td>Magnet Dev. Dep.</td><td>Test & Inst. Dep.</td><td>Materials Dev. Dep.</td></tr>
<tr><td>The lead engineer (in the sense of technical project engineering leader) and supervisor or project manager determine the level of risk analysis and nature of the graded approach.</td><td>Lead Engineer</td><td>The Department Head, using his judgment to determine if a formal risk analysis worksheet is needed.</td><td>The project manager and or the lead engineer make the determination. The determination is made based on impact to the lab (ie cost, safety, environment, public opinion, productivity)</td></tr>
</table>

<table>
<tr><td colspan="4">Who performs and documents/checks/approves the risk analysis worksheets?</td></tr>
<tr><td colspan="4">DH:
The Lead Engineer Supervisor or the Project Manager are identified as the entities documenting/checking/approving the risk analysis worksheets in coordination with the Lead Engineer.</td></tr>
<tr><td>SRF Dev. Dep.</td><td>Magnet Dev. Dep.</td><td>Test & Inst. Dep</td><td>Materials Dev. Dep.</td></tr>
<tr><td>The lead engineer and supervisor or project manager work through a risk analysis. We have some examples of risk analysis worksheets. Worksheets are not the only source of risk information. Risks in our R&D efforts have also been determined by component and prototype testing. For example, the blade tuner tests for 1.3 GHz cryomodules have revealed some risks in the drive trains in the design which was provided to us.</td><td>It depends on the project scale. For the conventional magnets called an internal review where included experts from other FNAL divisions. For large projects: LARP, Mu2e, 11 T Dipole, Project-X organized external reviews. Review results documented and kept in the project database.</td><td>Department projects started since the Engineering Manual was issued were low risk and did not require a formal risk analysis worksheet.</td><td>The project manager and lead engineer reviewed the worksheets together.</td></tr>
</table>

How are the required engineering reviews accomplished, approved, and documented?			
DH: Reviews are called by the lead engineer, project engineer or project manager and are typically performed by peers and subject matter experts not involved in the task or project being reviewed. Reviews documentation is stored on backed-up TD servers, although the format and location of the documentation are not uniform across the Division. Exceptions are the safety reviews, approvals, and documentation, which follow FESHM requirements.			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep**	**Materials Dev. Dep.**
Reviews are typically called for by the lead engineer, project engineer, or project manager. Much of our work is in a "matrix organization", so the line management is often not involved in assigning work or organizing the reviews. SRF department engineers working on the mu2e project, as mentioned above, are good examples of those working in such an environment. Reviews for that project are determined by and organized by the mu2e project managers. Project review approvals are by the review committee, with a review report written by the committee and edited by the committee chair. Safety reviews, approvals, and documentation follow FESHM requirements.	All documents of large projects are filed in the project databases. Other magnet documents are filed in the TD Project Server. Each magnet system has special directory with sub-directories: meetings, reviews, documents, test results.	Engineering reviews are accomplished by peers and subject matter experts from other Departments and Divisions. Action items and resolutions are documented and stored in the Department document web site.	NA

How are the designs, reviews, and other documents safeguarded (filed/indexed, etc.) in files, databases, libraries, etc?			
DH: All TD generated drawings are safeguarded in the FERMI-TDM (Team Data Management) system based on IDEAS. Storage of other documentation is performed across the Division although not in a uniform way, ranging from the used of project-related document management systems (ILC-dms for ILC, docdb for Project X), controlled TD documents (Material Dev. Dep.) or individual Department web sites (T&I activities).			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep.**	**Materials Dev. Dep.**
Document management systems such as ilc-dms and docdb are used for storing review documents, presentations, and review committee notes, comments, and reports. The specific database depends on the project. Safety review documents are archived both within TD and by the ES&H Section, depending on FESHM requirements and the nature of the documentation.	Engineering responsibilities and requirements shared on the base of matrix approach. The project manager and lead engineer assign tasks for engineers and they are responsible for their work coordination.	The Department has a dedicated web site with the ability to control electronic documents, index, and search files (www.tiweb.com). In addition, the original signed copies of controlled documents are safeguarded in designated cabinet files. Original CAD generated drawings are stored in the TD Drafting images database.	The designs and reviews are controlled TD documents. Other important but not critical information is stored on a project network drive (project photos, timeline, presentations, vendor and procurement info).

How are these Engineering responsibilities and requirements shared or otherwise handled where a group within a Division/Section/Center supports a Project?			
DH: Documentation responsibilities follow directly the assignment of engineering tasks.			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep.**	**Materials Dev. Dep.**
Authors of documents are responsible for uploading them to the document databases, sometimes with help from the supervisor, project managers, administrative assistants, or E&SH personnel.	Engineering responsibilities and requirements shared on the base of matrix approach. The project manager and lead engineer assign tasks for engineers and they are responsible for their work coordination.	NA	The project manager or lead engineer assigns tasks with input from manager or group leader of person who is assigned the task.

How are these Fermilab Engineering Manual activities handled when the engineering groups are external to Fermilab, e.g. Architectural Engineering firms or other collaborating institutions?			
DH: As a general rule, Fermilab engineers require external engineering groups to follow the Engineering Manual requirements with different degree of success. In several cases, FNAL engineers have to step in an initiate some of the documentation required by the Engineering Manual.			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep.**	**Materials Dev. Dep.**
We handle work for collaborating institutions as if it were for our own accelerator, documenting the project using our same FESHM requirements and whichever data management system the project managers request us to use. A good example was the 3.9 GHz cryomodule for FLASH at DESY, which was reviewed and documented as if it would be operated at Fermilab. Documents were all placed in the ilc-dms database with our other cavity and cryomodule operational readiness documentation.	We mostly collaborate with National Labs (LBNL, BNL, SLAC, JLAB,ANL, ORNL) and International Institutions (CERN, DESY, KEK, ITER, IHEP, etc…) which have similar requirements for the engineering work. The communication with other firms goes through special FNAL departments: FESS, Business Section, Procurement Department, etc…	It is very difficult to enforce the Fermilab Engineering Manual practices when work is done in collaboration with external organizations (e.g., other laboratories). We found some organizations (e.g., Indian Institutions) to be more responsive than others (e.g., DESY or LBNL). We typically had to initiate writing documents such as requirements specifications and design reports when working with organizations external to Fermilab.	The Fermilab responsible engineer specifies requirements for the external group to meet based on common practices in the engineering manual. The responsible engineer then checks to see if the requirements are met. If they are no met then an evaluation is done to see if the work must be redone or not. This is a standard part of the TD material control group and for larger items the procurement group.

If you have written procedures for any of these activities, please send just the titles and reference numbers of such documents.			
DH: See below			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep.**	**Materials Dev. Dep.**
We have many examples of documents including specifications, risk analysis spreadsheets, and review documents. We can assemble a list of these and make them available in whatever way works best for the purposes of the upcoming reviews. I would like to discuss further which documents should be made available.	NA	There are several Department procedures and guidelines that support the Engineering Manual activities, for example: • "T&I Department Engineering Work Process Guidelines", TID-N-59. http://tiweb.fnal.gov/website/controller/540 • "T&I Department Document Control Policy and Procedures", TID-N-73, http://tiweb.fnal.gov/website/controller/1167 • "T&I Department Records", TID-N-19, http://tiweb.fnal.gov/website/controller/446 • "T&I Department QA Program Description", TID-N-93, http://tiweb.fnal.gov/website/controller/1178 • "T&I Department Conduct of Operations", TID-N-15, http://tiweb.fnal.gov/website/controller/429	NA

<table>
<tr><td colspan="4">For your organization, over the last year: Approximately how many design efforts, however you define them, have been started?</td></tr>
<tr><td colspan="4">DH:
See below</td></tr>
<tr><td>SRF Dev. Dep.</td><td>Magnet Dev. Dep.</td><td>Test & Inst. Dep.</td><td>Materials Dev. Dep.</td></tr>
<tr><td>I only know of a few small projects. One could consider the PXIE 325 GHz cryomodule as a new start, although there was already work on 325 MHz cryomodule concepts for Project X. We can assemble a more detailed list given more time, if you need it.</td><td>The new 11T Dipole Program with CERN started in this year.</td><td>Over the last year, approximately 3 minor design efforts have been started in the Department</td><td>No new design efforts have started recently</td></tr>
</table>

How many design efforts were evaluated using the graded approach risk analysis worksheet?			
DH: See below			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep.**	**Materials Dev. Dep.**
A few smaller projects, cryomodule projects, and perhaps some others. Again, we can assemble a more detailed list but it will take more time.	Mu2e magnet system.	None	NA

How many of these design efforts that underwent the graded approach risk analysis worksheet required formal control due to having an element with risk score equal to 5 or sum of risk scores for a given chapter greater than the threshold presented on page 14 of the Fermilab Engineering Manual?			
DH: None			
SRF Dev. Dep.	**Magnet Dev. Dep.**	**Test & Inst. Dep.**	**Materials Dev. Dep.**
None	Most of our magnets designed and fabricated for R&D projects. The risk of these projects substantially reduced by proper planning of engineering activity. Initially the magnet design and fabrication technology proved by fabrication and testing short coils in mirror magnets, then 1 m long, and only after that 4 m models for LARP and 11 T Dipole. The final acceptance of the magnet prototypes will be considered only after successful magnet demonstration. These projects risk properly evaluated by CERN, and they have reliable backup options.	None	NA

Please submit an example of an outline of a complete documentation for one such design activity that has gone through the complete process as defined in the Fermilab Engineering Manual. A list of the drawing numbers and titles and reference numbers for other design documents, indicating author, approver, and date, will be sufficient, rather than a submittal of the entire actual documents.

DH:

We offer three design (and construction) activities for this assessment: the design of VTS2 and VTS3 cryostats, the design of the Mu2e magnets and the design of the Integrated Cavity Processing Apparatus in IB4.

SRF Dev. Dep.	Magnet Dev. Dep.	Test & Inst. Dep.	Materials Dev. Dep.
Since the manual is relatively recent, we have a few small projects which may serve as examples. Larger projects are still in early stages.	See Appendix 2 for the Mu2e effort	Appendix 3 is an outline of a complete documentation for a design activity for SRF Cavity Vertical Test Stand 2 and 3 Cryostats that has gone through the complete design and procurement process. This outline is from the T&I Department document web site, and can be accessed at http://tiweb.fnal.gov/website/controller/1359 (within the FERMI domain). More details and actual documents can be accessed from the corresponding folders, including copies of the mechanical drawings.	Information is provided for the cavity processing facility in IB4. • ER-9727 details the layout and integration of all major systems of the facility including plumbing, HVAC, electrical, and new equipment installation for the scrubber, safety showers, chemical storage room, electropolishing tool, partitions, and doors. • Specification for the HVAC system is 5500-ES-371071 “HVAC for ICPA”. • Specification for ductwork is 5500-ES-371072 “Ductwork for ICPA”. • Specification for chemical work enclosure for EP tool 5500-ES-371052 “Chemical Work Enclosure”. • Specification for Air Scrubber/Neutralizer 5500-ES-371048 “Scrubber REV-D”. • Specification of Clean-room 5500-ES-371049 “Clean room revB”. • Specification for ultra-pure water 5500-ES-371051 “Ultra-Pure Water Production Skid for Industrial Building 4 Integrated Cavity Processing Apparatus“. • Specification for spill containment 5500-ES-371050. • Overall facility design specification “5500-ES-371042-A ICPA Design Specification” • Drawings number 5520.000-MB-458963 through 5520.000-MB-458967 detail construction plans for the chemical storage room.

Finally, please submit your evaluation and suggestions of how the standardized requirements of the Fermilab Engineering Manual can be better implemented both within your organization and throughout Fermilab.
SRF Dev. Department (T. Peterson) • In my opinion (Tom Peterson), the engineering manual was written for projects which take place entirely within a particular organization and does not fit well with our matrix-type organization of projects. "Department Head" involvement is invoked thoughout the manual starting on page 9 with specifications. Again on page 10, "Lead Engineer and Department Head will complete the graded approach worksheet as part of the specification process." It will actually be Lead Engineer and supervisor or Project Manager. The emphasis in the engineering manual on the role of the "department head" should be changed to account for the matrix organization of projects. • R&D efforts, for example where we take existing designs like the INFN blade tuner or various RF cavities, test them and modify them, do not fall into these neat project definitions. We are often testing, troubleshooting, and revising designs from other organizations. CM1 and the subsequent 1.3 GHz cryomodules are good examples, although on a larger scale than many of our other R&D efforts. Although these R&D efforts do not fit into the Engineering Manual vision of a "project", we follow the spirit of the manual. For example, documentation such as is called for in the "testing and validation" phase (Chapter 7) is created for our tests of these R&D devices. • A third comment (again my opinion) is that the nature of our R&D projects is more iterative than the Engineering Manual assumes. For example, we began cryomodule design for Project X well before the requirements were specified. The risk analyses benefited from preliminary design work. Requirements were discovered during the design process (and are still being updated). My view is that development of requirements, risk assessment, and design happen in parallel in our R&D environment due to the many uncertainties involved. Nevertheless, the documentation and review processes called for in the manual still occur, but not in such a linear fashion.
Magnet Dev. Department (V. Khashikin) The FNAL engineering manual is a new document which in a very general way describes an engineering process. I think the main next step should be the organization of common FNAL database EDMS where each project will store engineering documents.
Testing and Instrumentation Department (R. Carcagno) Requirement specifications often come from the scientific community. Often times it is not easy to persuade lead scientists to write down the specifications and agree that sufficient effort and time must be allocated in the project to properly follow the Engineering Manual steps. There are few engineers in my organization responsible for a multitude of tasks, frequently shifting priorities, and demanding schedules. Under these conditions, it requires substantial line management buy-in and commitment to ensure continuous adoption of the Engineering Manual, especially when cultural shifts are required and old habits need to be broken. Publishing a manual and hoping that people will adopt it is not sufficient for a successful long-term institutional success. I believe a lot more focus and persistence is necessary to ingrain this work process consistently throughout Fermilab.
Materials Dev. Dep. (C. Cooper) • ***Scope change***: Many projects I have worked on have had substantial scope changes during the project. This is normal for R&D oriented projects. A scope change should merit a review of how all the chapters of the Manual are affected by the scope change, specifically the requirements and specifications and the graded approach worksheet. • A project that merits the use of the Engineering Manual should be evaluated using the guidelines listed in the Manual as soon as possible, regardless of the state of or bureaucratic labeling of the project at the time. Large projects that are in early stages would likely require several scope changes. Every time a new scope change and new evaluation of the project occurs all collaborators

in the project must be notified.

- The Manual in general is a good guideline on how to manage medium to large scale projects. There should be a guideline presented on how to handle small projects that don't warrant the use of the Engineering manual.
- The conditions or triggers for use of the manual are too subjective and should be specified. For example a trigger for Manual use could be the dollar amount for a project, the length of a project, impact to the lap, or safety and environmental impact.
- There is no mention of applying for or receiving of operational readiness clearance for projects. I believe this is a standard practice for all divisions.
- More guidance should be added in the Manual in the "Communications to Vendors and Subcontractors" section.

<table>
<tr><td colspan="4">Please note that this survey/assessment will provide input preparations for the DOE Integrated Service Center (formally CH plus Oak Ridge office) 3-year cycle Quality Review of Fermilab which is scheduled to occur over the July-September, 2012 timescale. The specific topic(s) for this review will be Design Controls and Engineering Requirements in AD and PPD. This DOE review will be in addition to the annual OQBP Quality Assessment of Engineering for all Fermilab organizations.</td></tr>
<tr><th>SRF Dev. Dep.</th><th>Magnet Dev. Dep.</th><th>Test & Inst. Dep.</th><th>Materials Dev. Dep.</th></tr>
<tr><td>We will be performing risk analyses and reviews of some of our newer, larger projects such as elements of the PXIE 325 MHz SSR1 cryomodule over the next few months which could be made available, also, as examples of engineering processes.</td><td>NA</td><td>NA</td><td>NA</td></tr>
</table>

APPENDIX 1: List of activities performed during the fabrication of the Cavity Processing Laboratory (CPL) in IB4, from Eng. C. Cooper.

- A scope of work was defined.
- A MS Project Timeline with milestones was developed.
- FESS and ES&H were contacted from the beginning of the project to make sure the proper safety precautions were taken, the correct codes were being followed and that the project integrated into the building properly.
- An external technical review was done on the facility and function of the main tool in the project. Comments/findings from the review were addressed in controlled documents.
- Engineering drawings were made and stored in the TD archival system for the main tool and the integration of the tool into the building. Technical notes were written and stored in the TD archival system as well.
- Most components for this project were on site before the Manual was released. The main deviation from the Engineering Manual in terms of procurement was that the lead engineer exactly specified everything to procure based on his expertise in the subject. The procurement department was not given a list of requirements for individual systems and asked chose products as the lead engineer specified each component.
- After parts arrived they went through QC/QA as needed. Manufactured parts went through CMM measurements to see if they met tolerances of the drawings. The reports are documented by the material control department in travelers. Several things did not meet specifications and had to be remade.
- Installation was overseen by the lead engineer and task manager based on peer reviewed facility integration and tool drawings.
- After installation, pre-operational readiness clearance documents were submitted and different parts of the facility were tested.
- The facility is operating well in the Pre-operational stage and is in review at the moment for full operational clearance.

APPENDIX 2: Engineering Risk Assessment spreadsheet for the Mu2e Solenoid project in TD

Engineering Risk Assessment Spreadsheet		
Instructions: Fill in the cell colored cells with your best answers to the questions:		
Go to the Requirements tab and follow the requirements listed in the green cells for each item.		
Completed by:		**T. Page**
Project:		**Mu2e Solenoids**
Date:		**1/10/2012**
Project Manager:		**M. Lamm**
Lead Engineer:		**T. Page**
Assestment	guidelines	
A) Technology		
The project will use off the shelf technology	1	
Engineers will purchase and modify off the shelf technology	3	
The project will require the development of new technology	5	
		4
B) Environmetal Impact		
There will be no environmental impact	1	
The project may have some environmental impact but will not require an		
environmental impact assessment, as determined by FESHM	3	
The project will require an environmental Impact statement	5	
		3
C) Vendor Issues		
Vendors could cause minor issues.	1	
Vendors could cause manageable complications	3	
Vendor issues could result in significant schedule delays or cost overruns		
or could otherwise jeopardize the successful completion of the project.	5	
		5
D) Resource Availability		
Resources will be readily available	1	
Resources could be somewhat restricted	3	
The difficulty of obtaining resources puts the project schedule at high risk	5	
		4
E) Quality Requirements		
The quality requirements can be met easily with existing infrastructure	1	
The quality requirements are challenging but can be met with existing infrastructure	3	
The quality requirements are beyond the capability or existing infrastructure	5	
		3
F) Safety		
The project will require standard safety considerations	1	
The project will require increased diligence due to its location, the configuration		

of the product or the type of work required. This includes required review		
according to FESHM.	3	
The project will require very restrictive safety considerations. This		
includes required review and personnel safety systems.	5	
		3
G) Manufacturing Complexity		
The manufacturing process will be routine	1	
The project will require an existing technology that the manufacture has not		
previously used.	3	
The project will require new or complex manufacturing methods.	5	
		3
H) Schedule		
Time will be unlimited	1	
The schedule will be somewhat constrained.	2	
The subject will be on the overall project critical path and has no schedule contingency.	5	
		5
I) Interfaces		
One department at Fermilab will be involved with a standalone project.	1	
Project success depends upon contributions from multiple departments at Fermilab.	3	
Project success depends upon contributions from multiple institutions.	5	
		5
J) Experience/Capability		
Only experts will participate	1	
A blend of experts and inexperienced personnel will participate.	3	
Only inexperienced personnel will participate.	5	
		3
K) Regulatory Requirements		
Regulatory agencies will have minor to no involvement.	1	
The Department of Energy, DOE will have direct regulatory involvement.	3	
DOE, as well as state or federal governments, will have regulatory involvement.	5	
		3
L) Project Funding		
A single source within Fermilab will fund the project.	1	
A source outside of Fermilab will fund the project.	3	
Multiple sources outside of Fermilab will fund the project.	5	
		2
M) Project Reporting Requirements		
Reports to senior management about the project will not be required.	1	
The project will require quarterly performance reports.	3	
The project will be highly visible. Top management or outside agencies will		
schedule visits and issues monthly performance reports.	5	
		5
N) Public Impact		

The public will not be affected.	1	
The public may be somewhat affected and should be informed with news releases.	3	
The project may have an impact on the public. The public should be involved		
through public forums and may participate in advisory councils.	5	
		2
O) Project Cost		
The project will be within the department operating budget.	1	
The project will require divisional budget planning.	3	
The project will require laboratory or DOE budget tracking and reporting.	5	
		5

APPENDIX 3: Complete documentation outline for VTS2 and VTS3 cryostat design and procurement in the T&I Department.

tiweb.fnal.gov/website/controller/1359

Fermilab

VTS 2 & 3

Powered by WebSite

Test & Instrumentation

VTS Home

Project Management

Exchange of Technologies under the Indian Institutions and FNAL Collaboration	Bruce Chrisman memo dated April 29, 2010
US-India MOU	January 9, 2006
US-India MOU Addendum III Supplement 1	August 2011
US-India MOU Addendum I	October 2, 2007
US-India MOU Addendum III	February 10, 2009
Management Team for VTS 2&3 Facilities	Memo from G. Apollinari, December 22, 2008
TID-N-243: IB1 Test Area SRF Projects Management Plan (PMP)	November 5, 2009
TID-N-249: VTS 2&3 Cryostats Statement of Work (SOW)	November 17, 2009
VTS-2 Design and Procurement Schedule	November 18, 2009

Design

TD-09-023: VTS 2&3 Functional Requirements Specification (FRS)	October 21, 2009
Preliminary Design Review	May 22, 2009
TID-N-244: Calculated LHe Invenvtory Usage for VTS Test Configurations	November 9, 2009
P&ID Review	October 27, 2009
VTS 2&3 Cryostats Technical Requirements Specification (TRS)	TRS Documents
VTS 2&3 Cryostats Technical Design Report (TDR)	TDR Documents
VTS 2&3 Cryostats Final Design Review (FDR)	December 8, 2009

VTS-2 Procurement

TID-N-258: VTS-2 Procurement Plan (PP)	January 20, 2010
VTS-2 Acceptance Tests and Results	June 20, 2011
VTS-2 Cryostat Vendor Design Review	Design Review Documentation
VTS-2 Cryostat Request For Information (RFI)	RFI Documents
VTS-2 Cryostat Procurement Specification (PS)	PS Documents
VTS-2 Cryostat Procurement Readiness Review (PRR)	January 27, 2010
VTS-2 Cryostat Request for Quotes (RFQ)	Open Date February 16, 2010

Operations

TID-N-437: Procedure for calculating cryostat heat load	Prabhat Gupta (November 21, 2011)

Safety

TID-N-329: VTS-2 & 3 Cryostats Internal Piping Flexibility Analysis	P. Gupta and A. Hemmati, March 30, 2011